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June 3, 1920

Engineering News-Record

Dam for ... Hydroelectric Proje...

Bridgewater Hydroelectric Development for Southern Power Company

Large Reservoir Formed by Three Widely Separated Dams

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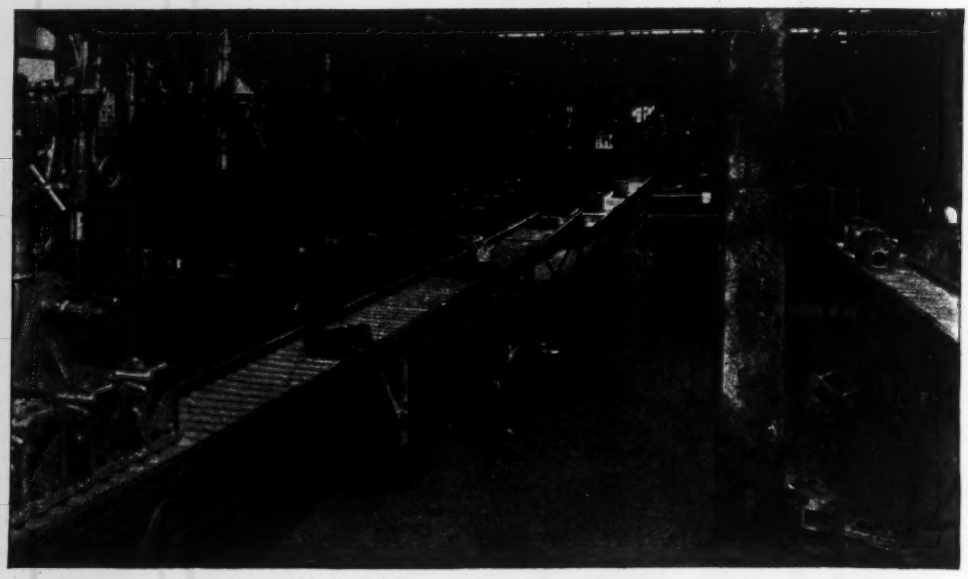

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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At Last a Water-Power Bill

AFTER twelve years of argument and disappointment a Federal water-power bill has passed both houses of Congress, but the history of the bill has been so tumultuous and its fortunes so changeable that it would not do to pronounce judgment or to forecast possibilities until the President has signed it. Probably it is too late to hope for active starting this year of any of the numerous projects that, by report at least, have been waiting on tiptoe for the passage of the bill. Once the President signs it, though, the Government agencies delegated to supervise our Federal water-power policies must immediately organize for service so that the preliminary details of licensing and rate-fixing can be completed and the decks cleared for construction at the earliest possible moment.

Politics!

HARD working taxpayers who put their country above their party will see red when they read the report of the Congressional investigation of the nitrate plants, noted on another page. Common sense will tell them that no human activity could be so completely bad as the Republicans make out the whole nitrate program to be nor so divinely perfect as the lone Democrat would have us believe. Normally, party politics do not come under the purview of this journal, but the recent congressional "investigating" committees have been "too much." If some one will get up a political party that is willing to admit that it is occasionally wrong and that its opponent is sometimes—even though not so frequently—right, we will support it. Temporarily, at least, our opinion of the American people is at a low ebb, because such drivel as this report is obviously what they like, else men shrewd and practical enough to get into Congress would not feed it to them.

Art in Engineering Detail

ROUGH-AND-READY differentiation between the art and the science of engineering, however useful and necessary, is likely to result in obscuring the inherent unity of the two. The same habit of thought and the same methods are brought into play by operations that are strictly part of the art of engineering rather than its science, as by the most highly technical analysis or computation. This is perhaps most apparent, and most instructively so, in the treatment of details. A discussion of stray points in structural design, whose concluding installment is published in this issue, instances how even very "practical" items of engineering are pervaded by reasoning and conclusions of purely scientific character. The fact that many problems are not susceptible of treatment by formula should not mean that they may safely be handled by unguided judgment alone. The true course of solution lies in a fair estimate of the influence of those factors that cannot be measured or introduced into the calculation directly. In most of the detailing that engineering operations involve, this is the case, and correspondingly detailing is a most fruitful field for applying the art of engineering in its truest way.

Destructive and Suicidal

ENTIRE control of the building industry in St. Louis is apparently sought by the local Building Trades Council, judging from a resolution recently passed by that body. The resolution, which becomes effective Sept. 1, has a two-fold aim: To force owners to let contracts upon every bit of construction simultaneously, and to make mandatory the filing with the Trades Council of the names of all bidders. The council, in a recent letter to St. Louis architects, contractors, associations of general contractors, and master builders "expects that owners and architects will let their contracts to one of the contractors or shops approved by the council." It does not seek to "recommend any particular contractor or shop" but simply to approve a list of those "in harmonious relations" with the council. The expressed purpose of the council's action is to avoid strikes or delays in construction work "due to the presence of non-union men." By the provisions of the resolution, therefore, if a contractor employs union labor exclusively his efforts to secure a contract or execute one will not be interfered with by the council. Should he, however, run an open shop, he begins work with a foresworn enemy and with little chance for success. The single aim of the resolution is too crudely apparent—the elimination of all open-shop competition. The action of the council is too clearly another outcropping of an intention shown by many radical labor organizations to control all industry. When will the unions realize that such attempts threaten the very life of industry and the whole common good and are therefore suicidal?

Business Recognizes the Engineer

AT ALMOST every meeting of technical men these days one hears pleas for a closer association between engineers and business men. Professional aloofness is now recognized as one cause which has prevented a fuller understanding of the engineer by the public and, in consequence, has operated against proper recognition and the material benefits which generally accrue therefrom. While there has been much talk, the sum total of actual results has been far short of what is desirable. It is well worth noting, therefore, that a real step forward was taken last month when the United States Chamber of Commerce, for the first time in its history, named two engineers, L. B. Stillwell and Howard Elliott, as directors. To the American Institute of Consulting Engineers, which has been a member of the

Chamber since 1914 and which was represented at the recent annual meeting by George W. Fuller and Colonel F. A. Molitor, much of the credit for the results accomplished is due. The chamber's action means that the engineering profession has been officially recognized as an important influence in the conduct of the nation's business. In future councils of business, therefore, the voice of the engineer will be heard. In the world's progress the engineer feels that he is a vital factor, but the drawback has been that he has not taken the trouble to make the public accept the same point of view. Hence the complaints within the profession about inadequate compensation and lack of status among men. For these conditions the engineer himself is largely to blame. He has stood apart from the rest and, instead of helping shape public opinion, has been content to accept himself at the public's valuation, instead of at his true worth to society. With engineer directors in the United States Chamber of Commerce, however, the policies formed by that body—the mouthpiece of business—will not in future represent solely the views of merchant, manufacturer and banker.

Valuable Service Not Appreciated

INADEQUATE compensation is depriving our cities of their best public servants. The case of the city engineer of Worcester, 43 years in the employ of the city, was noted in our issue of April 15, p. 746. Since then the City Council voted Mr. McClure a salary increase of from $4,000 to $6,000, but the mayor vetoed the increase and for weeks the council remained unable to agree on what to do next. As a result, Mr. McClure will leave the city on June 30, after 43 years of devoted service, and just as the city is starting on a large sewage-works project.

A Start in the Right Direction

IN passing an ordinance directing the city manager of Xenia, Ohio, to assess and collect water rates sufficient to provide for operating expenses, interest on bonds and sinking fund redemption, the City Commission has made a right start after taking over the water-works from a private company. Unfortunately this action does not appear to have been taken from a sense of sound municipal policy but because unless the works are made self-supporting the bonds issued to pay for the works will carry the city's debt limit beyond the statutory limit. The city should now go further and provide for an equitable distribution of the water-works expenses and capital charges between the city as a whole and private water consumers.

Plank Surfacing for Secondary Highways

CORRESPONDENCE with ten widely separated state highway departments as to the feasibility of constructing plank surface roads for secondary highways indicates that such construction is impractical for two reasons: The present prohibitive price of lumber, and the rapid depreciation of plank surfacing even under light vehicular traffic. States in the lumber producing sections of the Middle West and Far West estimate that lumber needed for such construction, as outlined by Mr. Kershaw in *Engineering News-Record*, May 27, p. 1052, would be at least twice the figure quoted by him. Some states even put the price as high as $65 per thousand feet, board measure, at roadside. Mr. Kershaw's design was also considered inadequate as to thickness of surfacing planks. The consequent increase in the amount of lumber needed to carry even normal traffic would make his suggested type of surfacing exceed in cost some light bituminous types. Judging from letters received from states where lumber is most plentiful it is apparent that the plank surface highway has little place in modern road construction.

Over-Promotion of Roads

TWO communications received recently by the same mail indicate sharply the complexity of the road problem from the engineer's view. One came from an automobile publicity department and the second from a road engineer in Arkansas. The first was a flamboyant facetious mimeographed publicity sheet in the guise of a local newspaper story, suggesting the formation of a national automobile political party. The "news item" stated that there are more than seven million motor vehicles in this country, and suggested that if the owners would all vote the national automobile ticket they could swing every national and state election. Planks in the platform, which were supposed to be the ideas of the local distributor of automobiles (a space being left in the copy for the editor to fill in his name) are as follows: (1) Good roads everywhere with a just distribution of the cost thereof; (2) scientific supervision of gasoline sources of production; (3) fuller use of highways for passenger transportation by motor car and freight transportation by motor truck, both to be encouraged by the Federal and State governments; (4) widening of highways wherever necessary to care for the constantly growing volume of automotive traffic; (5) a scientific investigation of license rates and a just way of determining them; (6) for president, a big automotive business man who could operate the nation on the same basis of efficiency as he employs in operating his factory.

The paragraph from the engineer's letter is as follows:

"One of the very interesting features of the road problems to be solved in this state, is the fact that we are cutting brand new roads through wild country and we find the heaviest motor trucks ready to start hauling over these roads the day they are completed. In the older states we had years after the roads were first built to prepare for such traffic. What is a state to do that cannot afford expensive paved roads when such traffic takes possession of any highway that we attempt to improve with a little gravel or macadam? Of course we expect to pave a lot of the roads, but it would be a big help to civilization just to build light gravel roads in some of the back woods counties so that the natives, who have never been off the plantation on which they were born, could drive their mules to the county seat once a year and pay their taxes. The work now under construction and projected will cost some $5,000,000. I expect to see these communities develop very rapidly during the next few years. They are forty years behind the times, but they have all the good things that made the other states develop."

Of course the advertising man in Detroit who wrote the platform knows that the whole idea of a national automobile party is foolish but it makes snappy "copy" for the country editors and the automobile interests must promote the building of more roads or the satur-

tion point will soon be reached. On good authority it is stated that the total output of 5,000,000 machines which manufacturers planned to turn out in 1920 has been cut materially and the 1921 quota halved. Reports also indicate that labor is not so scarce in Detroit as it was a month ago. The engineer's letter shows the effect of the over-promotion by the automobile interests. What a costly experiment it is going to be for Arkansas. Motor trucks "taking possession" of her newly made light traffic roads through almost virgin territory will surely ruin them in a season. The engineer cannot possibly locate the paved roads in the right place until the country starts to develop. There is need for a most careful planning to get the through routes properly allocated and for regulation to keep box-car loads off the by-ways. A country forty years behind the times cannot spring forward over that period of time in a year by the simple act of building roads. The reversion to type will be swift and the local sentiment vindictive if the roads are ruined by outside interests almost before the mules are hitched to take the long contemplated trip to the county seat. The engineer will then be in a precarious position for not having built the proper road or foreseen the future traffic requirements.

Ultimate Irrigation Plans in Utah

PLANS made to expand the "cradle of irrigation" in America, the Salt Lake district, to its ultimate limit were explained on p. 1064 of our issue of May 27. Small attempts at irrigation were early made about the missions in California and in the Southwest a little irrigation was done by the Indians but little was known of it. In 1847 a small band of hardy pioneers of the Mormon faith reached the shores of Great Salt Lake and began there, in the very midst of the arid West, the diversion of the mountain streams to the desert lands. Thus was irrigation inaugurated in arid America by the Anglo-Saxon race. Operations have been expanded from one stream to another and a few reservoirs have been constructed, for long ago the natural flows were appropriated. Further developments require the building of dams to impound flood waters only and high-line canals to reach areas on the upper benches. Knowing full well that there is more land than water, and that the best plan for all concerned might not be possible after individuals and smaller communities developed local supplies in the easiest way, eight counties in northern Utah formed the Utah Water Storage Association to lay out the development of the water resources of this part of the State as a whole so that any future work may fit into the plan.

The most interesting item in the report recently issued is the proposed scheme of interchange of water over several watersheds from the Northeast to the Southwest. Figuratively speaking, it means tipping water from one basin into another so that the latter may in turn tip an equal amount into an adjacent basin, all with due regard to the prior rights of the intermediaries, whose benefit will come from a more stable supply for themselves and from living in an expanding country. Thus will water, belonging to the Colorado River system, be brought into the no-outlet watershed of Great Salt Lake. It will be many years before the whole scheme is an accomplished fact, but whatever is done will work toward this end. Many intricate Federal, state and local adjustments must be made, but in Utah the give-and-take principle has long been practiced. With this broad viewpoint of the greatest good for the greatest number in mind, it is easy to see much prosperity ahead for the people of Utah.

Recognizing the Human Elastic Limit

WHY WILL so many engineers who show a sense of proportion and fitness in their daily work present a paper before an engineering society which is far too long to be read aloud? These engineers recognize that there is an elastic limit in structural materials but fail to see that human beings have their elastic limit as well—especially after a hard day's work in their offices and while foregoing their usual evening at home or club. It is high time society members did something more than voice disapproval of such papers among themselves. They should join forces in getting action by their society; action that will not only disapprove such papers but will see that they are not presented.

There is seldom any good reason for actually reading a paper. If the speaker knows enough about a subject to warrant his making an address upon it, even if he be unused to speaking, he can prepare topical notes that will suffice as a guide to logical presentation. But bad as it is to read a paper, it is far worse when the paper consists largely of detailed matter, particularly figures, which the hearers cannot possibly remember. Yet again and again the desire to include details is made the excuse for reading the paper instead of presenting it orally. It may be desirable to write out the paper in detail so it can be printed and circulated and filed for reference, but that is another matter. If the subject cannot be presented without detailed figures or written formulas it is not suitable for presentation at a meeting. Time devoted to minutiæ is not only time lost but it may deprive those present of any benefit there might be in a general discussion following a short, ably presented paper.

Offhand, spontaneous comment that sometimes follows a paper concluded early in the evening may be of more value than the paper itself. It is true that too often no discussion whatever is forthcoming. That indicates something wrong and is no excuse for permitting evenings to be wasted in dawdling presentations. If the subject is a live one the secretary can always arrange in advance with a few members to come prepared with short discussions.

A technical paper that is published where it may be used for reference is one thing and an address on a technical subject in open meeting is quite another thing. Until would-be speakers learn what that difference is, technical societies would do well to adopt and print some form of specific instructions to speakers—or to readers of papers, where papers are read. This might be done in a leaflet headed "Specifications for Speeches and Papers" which the secretary could hand to those with whom arrangements are made for addressing the society. Living up to rules stated in a half dozen pointed paragraphs under such a heading might save members of technical societies from hours of agony.

Finally, we again urge that in presenting papers or in making speeches the engineer who is addressing an audience—any audience—should remember that human beings, like structural materials, have elastic limits which he must recognize or run the peril of failure.

Reservoir and Plant for New Southern Water Power

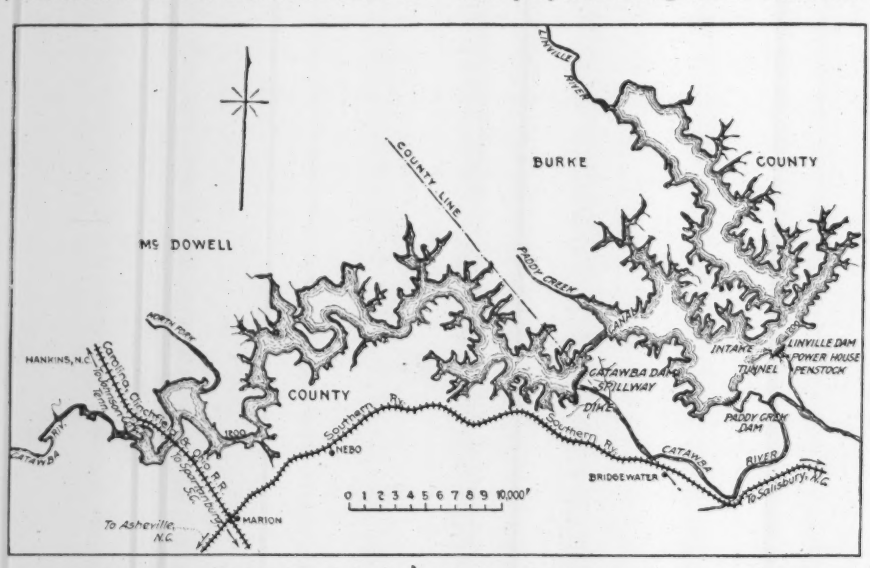
Hydraulic, Structural and Equipment Features of the Bridgewater, N. C., Project of the Western Carolina Power Co.—Storage Reservoir Formed by Three Widely Separated Dams

By William S. Lee,
Vice-President and Chief Engineer,
Southern Power Company

and

Richard Pfaehler,
Hydraulic Engineer, Western Carolina Power Company, Charlotte, N. C.

STORAGE capacity not only for a new hydro-electric station but for a number of allied down-river plants has been provided in the large Bridgewater project in North Carolina, which was commenced in August, 1916, and put into operation last fall. All but one of the hydro-electric plants operated by the Southern Power Co., of Charlotte, N. C., are located on the Catawba River. In order to increase the primary power output at these plants it was decided by the Western Carolina Co., an organization affiliated with the Southern Power Co., to build the Bridgewater reservoir to retain the high-waters of the upper Catawba River and its tributaries and to yield them during the periods of low water on the lower Catawba River. The water discharging from the reservoir is conducted to the new Bridgewater power station by a short tunnel and penstock before it continues to flow in the old river bed. The operations included the construction of three separate dams as well as the powerhouse and appurtenances.



THE BRIDGEWATER RESERVOIR FORMED BY THREE SEPARATE DAMS

Hydraulic Conditions

The drainage area of the Catawba River tributary to the Bridgewater storage reservoir is 370 square miles and the average annual rainfall is from 55 to 60 in. The headwaters of the Catawba come from the steep slopes of the Blue Ridge and Linville Mountains and floods are frequently caused by heavy rains. The highwaters of August, 1908, were considered to be the most severe on record until they were exceeded, by more than 100 per cent, by the floods in July, 1916, which were due to unprecedented rains falling over the eastern slopes of the Blue Ridge Mountains. These rains were caused by the movement of two tropical cyclones, one passing inland over the Mississippi coast and drifting over northern Alabama and eastern Tennessee into the Carolinas, and the other moving in from the Atlantic until it had reached western North Carolina. According to the "Monthly Weather Review" of August, 1916, the rainfall at Altapass, N. C., which is lying on the dividing line of the Catawba and North Toe (Tennessee) River, was measured to be 19.32 in., between 2 p.m. July 15 and 2 p.m. July 16, 1916.

Using the highwater records compiled by the Southern Power Co., it is estimated that, on July 16, 1916, the maximum discharge of the Catawba River into the then proposed Bridgewater Reservoir corresponded to 150 cu.ft. per sec. per square mile drainage area, which is equivalent to a depth of water of 5.58 in. over the whole watershed. For comparison, the precipitations determined by the U.S. Weather Bureau at stations in or adjacent to, the Bridgewater basin are given in Table I. It will be seen that the rainfalls on two successive days were uniformly high throughout the district.

TABLE I

Station (North Carolina)	Daily Precipitation in Inches July 15, 1916	July 16, 1916
Altapass	3.90	19.32
Blowing Rock	9.85	6.50
Marion	7.83	3.69
Morganton	4.67	4.79

In view of the fact that the Bridgewater reservoir is located within an area which is subject to torrential rains, a spillway capacity is provided which will correspond to twice the record discharge of July 16, 1916, over the entire watershed, before the reservoir level will reach the top of any of the impounding earth dams. The quantity of flood run-off which may be absorbed by the reservoir capacity is disregarded in the estimate.

Storage Capacity of Reservoir

The Bridgewater storage reservoir consists of the three arms formed by the valleys of the Catawba River, Paddy Creek and Linville River. The available storage capacity contained in the Paddy Creek and Linville valleys is 7,266,244,000 cu.ft., and in the Catawba valley 5,315,599,000 cu.ft., giving a total capacity of 12,581,843,000 cu.ft. The Catawba River carries about 75 per cent of the entire flow discharging into the Bridgewater reservoir, whereas the available storage capacity in the Catawba valley is only 42 per cent of

the total reservoir capacity. By means of a canal of about 2,500 ft. length, it is, however, made possible to divert portions of the flow carried by the Catawba River into the Paddy Creek and finally into the Linville arm of the reservoir. The canal cross-section is of ample size so as to permit the floodwaters to pass through the canal at low velocities, whenever the water surface in the Catawba arm is above El. 1,167. When full, the water surface of the entire reservoir is at El. 1,200 covering an area of 6,509 acres.

Economic Value of Reservoir

As long as the water surface is above El. 1,167 all the water stored in the reservoir will be discharged through the turbines at Bridgewater Station. Below El. 1,167 no flow may be passed through the turbines at Bridgewater Station and no flow may be passed through the diverting canal; the water stored in the Catawba valley down to El. 1,110 must be discharged through any or all of the four 6 ft. diameter sluice gates provided in the masonry spillway. It is the intention to stop operation of the power station as soon as the water surface of the Paddy Creek and Linville reservoir is below El. 1,150. The stored water between El. 1,150 and El. 1,105 may be utilized, however, to make up a portion of the deficiency in flow of the Catawba River below Bridgewater Station by opening the two 4 ft. diameter turbine relief valves and the 6 ft. diameter gate valve provided at the downstream end of the steel penstock.

The estimated annual flow into the reservoir is indicated in Table II.

TABLE II. GIVING THE NUMBER OF TIMES THE BRIDGEWATER RESERVOIR MAY BE FILLED IN ONE YEAR.

Class of Year	Mean annual run-off per sq. mi. drainage area cu. ft. per sec.	Total annual run-off on watershed Billion cu. ft.	Number of times reservoir may be filled during year to El. 1200	
			Lowest Water El. 1150	*Total available storage exhausted
Extreme dry ...	1.5	17.502	1.83	1.39
Medium dry	2.0	23.357	2.44	1.85
Medium wet	3.0	35.005	3.66	2.78
Extreme wet ...	3.8	44.340	4.64	3.52

*Lowest water elevation at 1,105 for Linville & Paddy Creek reservoir and at 1,110 for Catawba reservoir.

Using the records obtained by the U. S. Geological Survey for the Morganton, N. C., gaging station the following discharges applicable for the Bridgewater reservoir were deduced:

Year	Mean Annual Run-off per Sq. Mi. Drainage Area in Cu. Ft. per Sec.
1904	1.43
1905	2.14
1906	3.43

Not considering the Bridgewater power station, the water discharged from the storage reservoir will be available at the following Southern Power Company's plants:

Name of Station	Head at Station in Ft.
Lookout Shoals	76
Catawba	24
Fishing Creek	51
Great Falls	69
Rocky Creek	61
Wateree	72
Total	353 ft.

Using this head of 353 ft., a station efficiency of 80 per cent, and the total available storage capacity of 12,581,843,000 cu.ft., the potential energy contained in the full reservoir is 83,667,000 kw.-hr. The potential energy referred to the Bridgewater Station, considering the available storage capacity in the Catawba valley between El. 1,200 and El. 1,167 and in the Paddy Creek and Linville valley between El. 1,200 and El. 1,150, is estimated to be 18,940,000 kw.-hr.

Required Station Capacity

The conditions are that, in addition to the existing minimum monthly power output, an output of 17 million kw.-hr. shall be obtained at the stations on the Catawba River by use of stored water from the Bridgewater reservoir. Using an average head of 115 ft. at the Bridgewater Station and a combined head of 353 ft. at the six other plants on the Catawba River the proportionate additional monthly station output of the Bridgewater Section above its primary power output will be 4,177,000 kw.-hr. The estimated minimum monthly out-

END OF CATAWBA DAM EMBANKMENT AND THE BRIDGEWATER POWER HOUSE

put of the Bridgewater Station without storage regulation, would be 1,447,000 kw.-hr.; the required maximum monthly output of the Bridgewater Station will be, therefore, 5,624,000 kw.-hr. The actual installation is 20,000 kw. giving a load factor of 39 per cent under these extreme conditions.

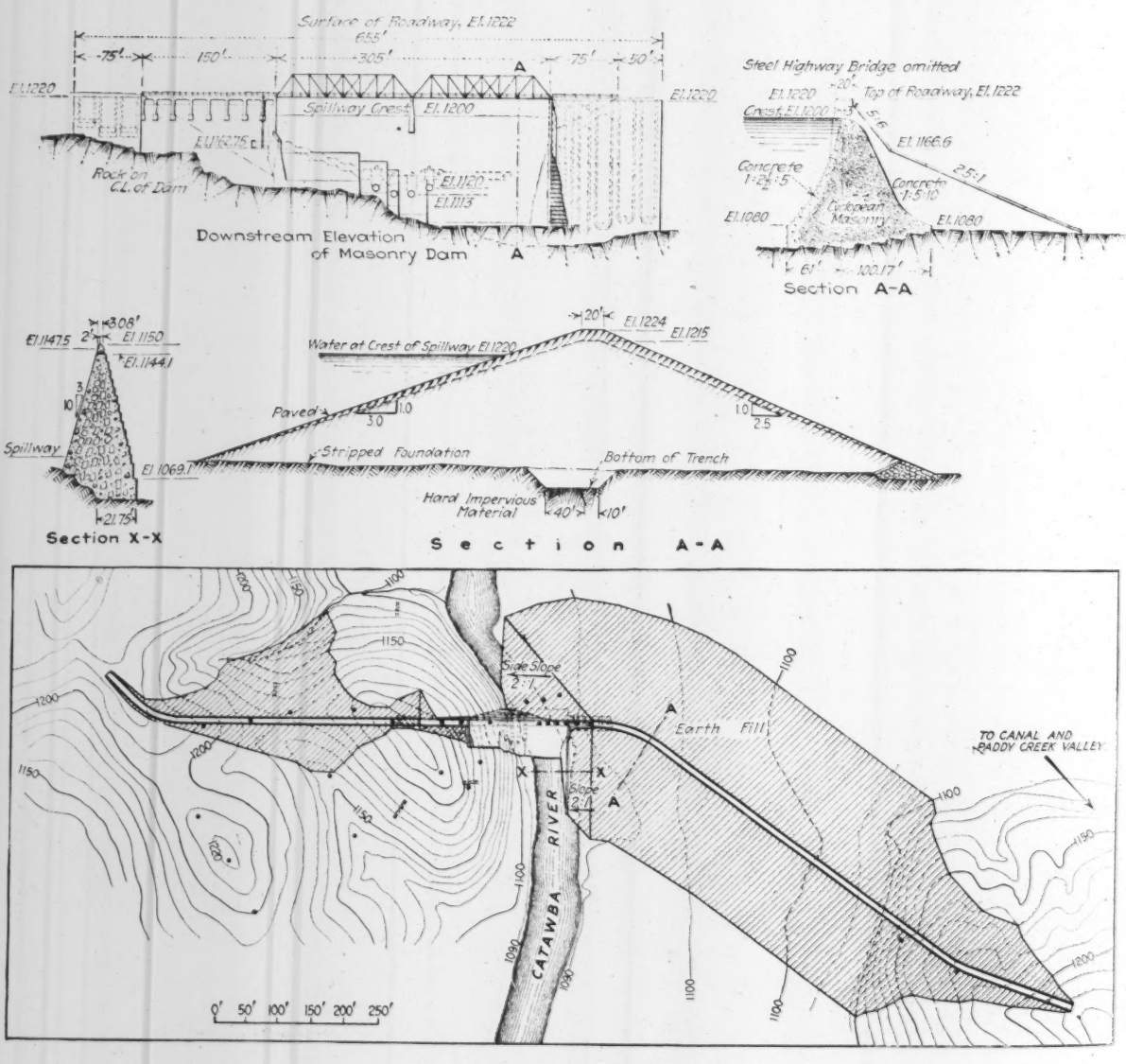
Designing Features of Structures

Owing to the fact that the tracks of the Southern Ry. run along the Catawba River at and east of the town of Bridgewater, N. C., it was found impracticable to consider the construction of a high dam across the Catawba below the mouth of the Linville River. It was, therefore, decided to build separate impounding structures in the Catawba, Paddy Creek and Linville valleys. The sites selected are all located within a radius of 2½ miles from the railroad station at Bridgewater. The topographical and geological conditions encountered at the three dam sites precluded the use of concrete masonry dams. An abundance of suitable earth fill materials was, however, available at the three sites, and earth dams were adopted, the specifications calling for the construction of the dams by the use of steam shovels and the hydraulic sluicing method. In this connection it may be mentioned that the total amount of earthfill materials involved in the entire work was 4,520,000 cu.yd. The spillway structures and extensions tying in with the earthfill work are of cyclopean masonry.

Conforming to the three main arms, of which the Bridgewater reservoir consists, the entire development is subdivided in three zones marked Catawba River work, Paddy Creek work and Linville River work, respectively.

Catawba River Work—The short length of the diverting canal between the Catawba and Paddy Creek valleys, and the fact that the Catawba riverbed and the lower portion of the hill forming the right bank consist of rock favorable for the foundation of a 125 ft. high masonry spillway, were the determining factors in the location of the Catawba dam.

A number of borings and test pits made at the site disclosed the fact that the bottom land on the left side of



DETAILS OF THE MAIN CATAWBA DAM

the river is underlaid by a water-bearing stratum of round river gravel and boulders beginning about 12 ft. below the surface and having an average thickness of 6 ft. Since it was essential to have a watertight core for the 120 ft. high earth dam to be built over and across this bottom land, it was specified that a trench of 50 ft. minimum width at the bottom should be excavated down to impervious ground and backfilled with selected material.

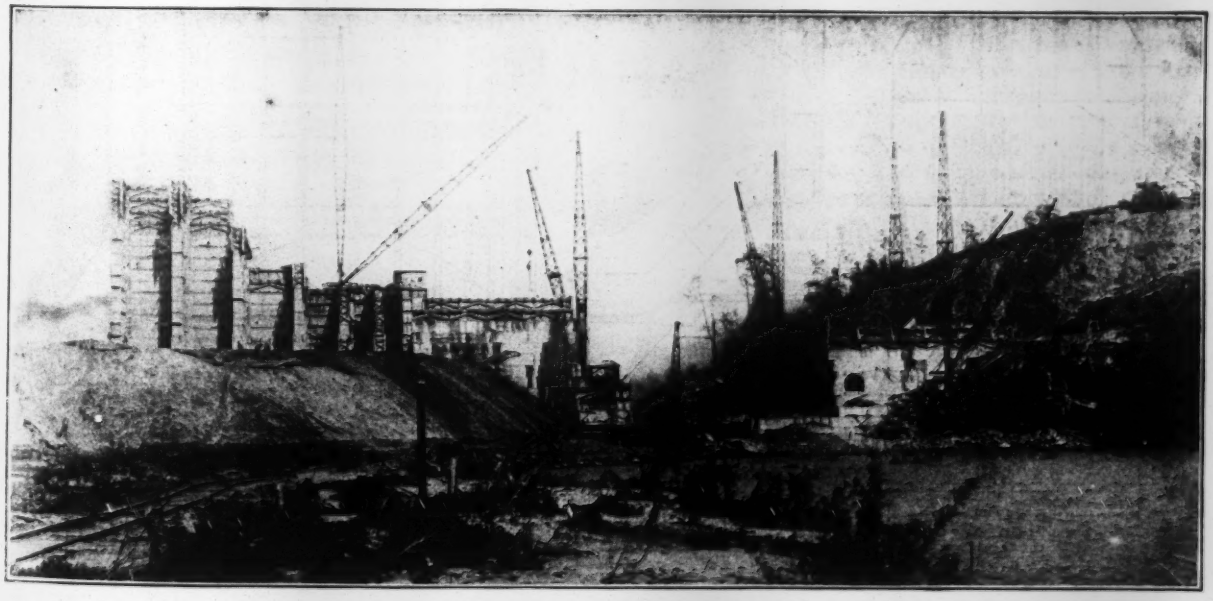
In order to obtain a satisfactory seal between the north end of the 305 ft. long spillway masonry across the riverbed and the earthfill, a 125 ft. long concrete core-wall with seven fins, each extending 27 ft. 11 in. upstream, is provided. The corewall proper and the fins rest on a common concrete masonry base of 39 ft. 5 in. width and 12 ft. minimum thickness going down to rock foundation; the maximum height of the corewall above the base is 165 ft. A retaining wall of concrete masonry is running 274 ft. downstream measured from the vertical plane through the spillway crest. The upper part of the 75 ft. long portion of corewall nearest to the spillway is built in form of a U abutment. On the upstream side, the sloping earthfill material is retained by the spillway masonry. To protect the upper portion of the downstream side slope from the action of highwater passing over the spillway, a splashwall is provided connecting the retaining wall with the face of the U abutment.

The ogee masonry spillway is of the gravity type and designed for uplift at the base decreasing in a parabolic function from full hydrostatic pressure at the heel to zero at the toe.

As previously mentioned, the lower portion of the hill on the right side of the river consists of rock (gneiss) gradually changing into disintegrated material and clay toward the surface. Taking these geological conditions into consideration, the gap between the spillway and the hill side is closed up by a 150 ft. long masonry bulkhead decreasing from a height of 102 ft. to 60 ft. with the top 22 ft. above the level of the spillway crest. A 75 ft. long corewall, with four fins on the upstream side, is extending still further into the hill and connects with a small earth fill required for joining the south end of the Catawba work with the existing grounds lying above the highwater line of the reservoir. The construction trench cut through the hill is backfilled with selected material and forms a portion of the above mentioned small earthfill; beginning at the junction of the corewall with the bulkhead, the earthfill is given a side slope. A short diverting splashwall is provided on the south end of the spillway, with outlines similar to those on the north end.

The 20 ft. wide top of the Catawba earth dam will be portion of a public highway, and the reservoir crossing is effected by two 153 ft. long steel spans of the through

CATAWBA DAM UNDER CONSTRUCTION



CATAWBA DAM. CORE WALL WITH FINS SHOWN AT LEFT

truss type supported by a reinforced-concrete pier in the center of the spillway. The top of the bulkhead and of the U abutment on the north side of the spillway carry a reinforced-concrete slab bridge.

All the material excavated from the diverting canal cut is used for the construction of the Catawba earth fill.

Paddy Creek Work.—There is a ravine at the lower end of the ridge between the Paddy Creek and Linville River valleys, and the indications are that the Linville River formerly passed through this gorge before it carved its present way through the hill to reach the Catawba River. The site selected for the Paddy Creek dam is below this ravine so that a natural channel is formed between the Paddy Creek and Linville River valleys, by means of which the waters stored in the Paddy Creek valley may be passed into the Linville basin even if the reservoir is drawn down more than 100 ft. below the spillway crest level.

No masonry is involved in the construction of the Paddy Creek dam; but it is estimated to contain 1,450,000 cu.yd. of earthfill materials. The upstream slope of the fill is covered with riprap. To provide an outlet for seepage water accumulated within the dam area, the downstream toe across the riverbed and the bottom land is built of rockfill material having an average height of 15 ft. The maximum height of the dam is 165 ft.

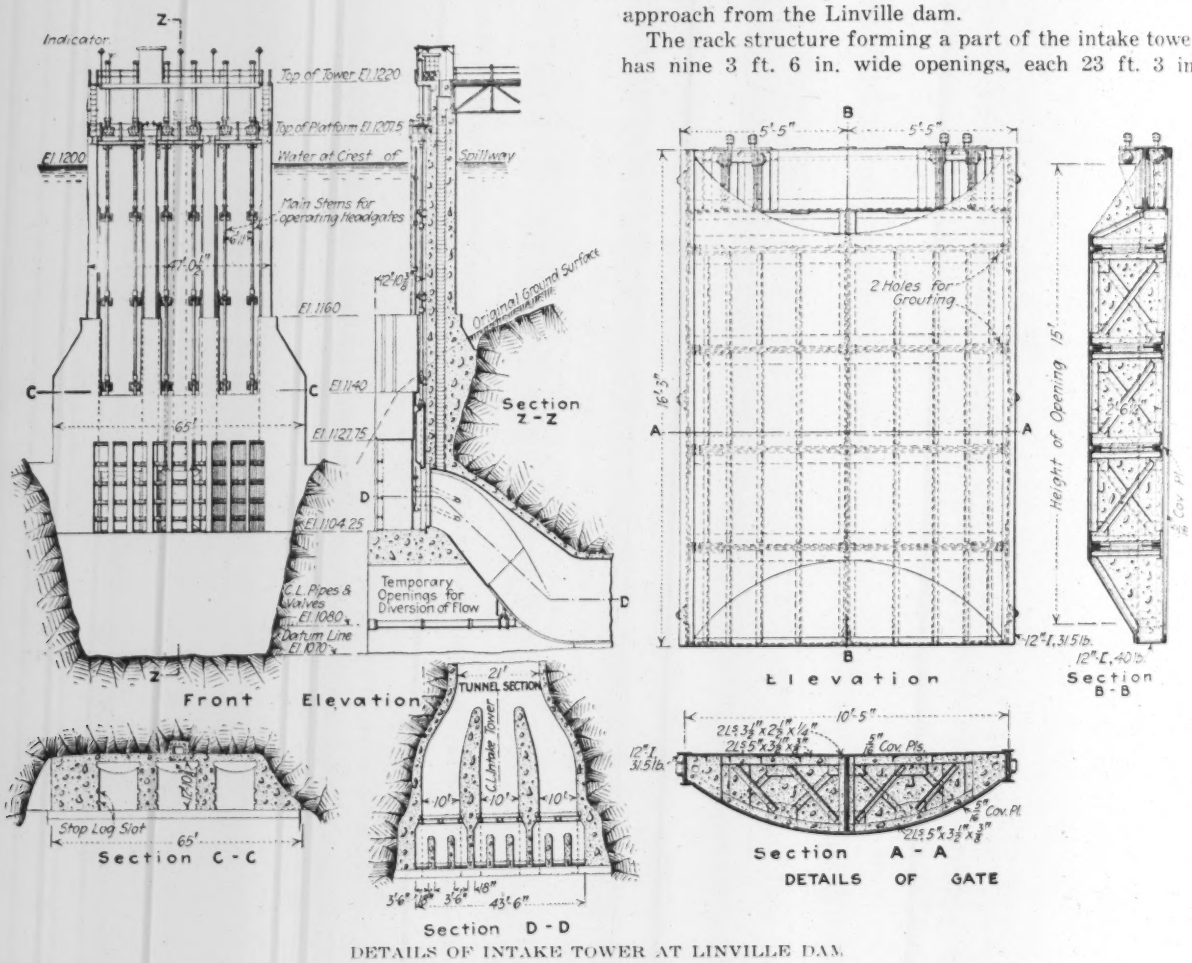
About midway between the Paddy Creek and Linville River dam sites, a depression in the ridge has been further deepened to bedrock and enlarged so as to obtain an additional spillway for discharging the floodwaters into the Catawba River.

Linville River Work.—The most favorable conditions for the location of a dam were found in the Linville valley where the river breaks through the last obstructing range of hills to join the Catawba River. A bluff consisting of gneiss rises immediately on the right side of the river, and in view of the fact that the normal water level of the Linville River is 17 ft. lower than that of the Catawba River, measured below the respective dam sites, it was decided to pierce this bluff by a tunnel and build the power station right below the Linville dam, at a point where a small grist mill was formerly operated by water power.

The Linville dam is built entirely of earthfill material with the exception of the 12 ft. high rock fill forming the downstream toe. The upstream slope is covered with riprap. It is estimated to contain 1,250,000 cu.yd. of earth fill materials and the maximum height is 160 ft.

The normal flow of water used in the design of the Linville tunnel intake is 2,000 cu.ft. per sec. The top of the intake opening is at El. 1,120 permitting an 80 ft. draw-down of the reservoir without decreasing the wetted intake area. Measured from its foundation the intake structure has a total height of 150 ft. and a steel foot bridge of 5 ft. width and 80 ft. span is provided to connect the top of the tower with the earthfill approach from the Linville dam.

The rack structure forming a part of the intake tower has nine 3 ft. 6 in. wide openings, each 23 ft. 3 in.

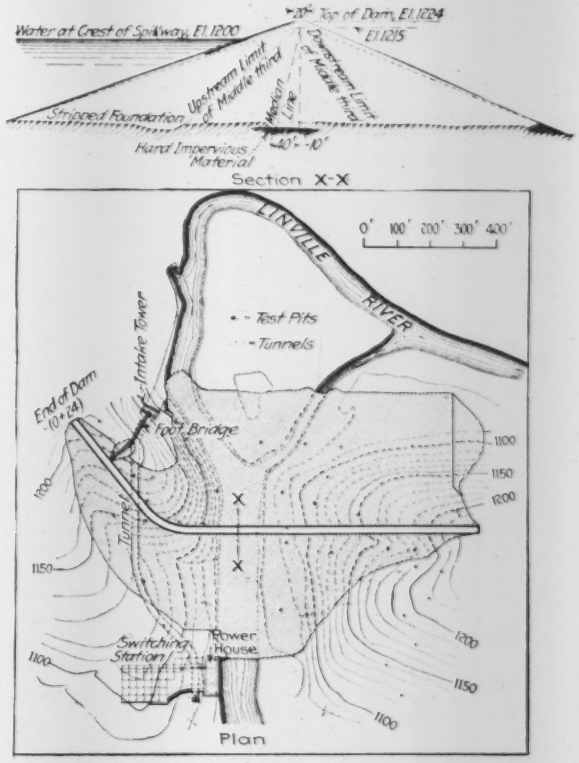


DETAILS OF INTAKE TOWER AT LINVILLE DAM

The 18 in. thick reinforced-concrete baffle piers between these openings are designed to transmit the proportionate amount of water pressure, which may be caused by the clogged-up racks, to the 12 ft. 3 in. high masonry block with top at El. 1,140. This masonry block contains three openings, through which the headgates may be passed for closing up the three 10 ft. wide by 15 ft. high intake openings.

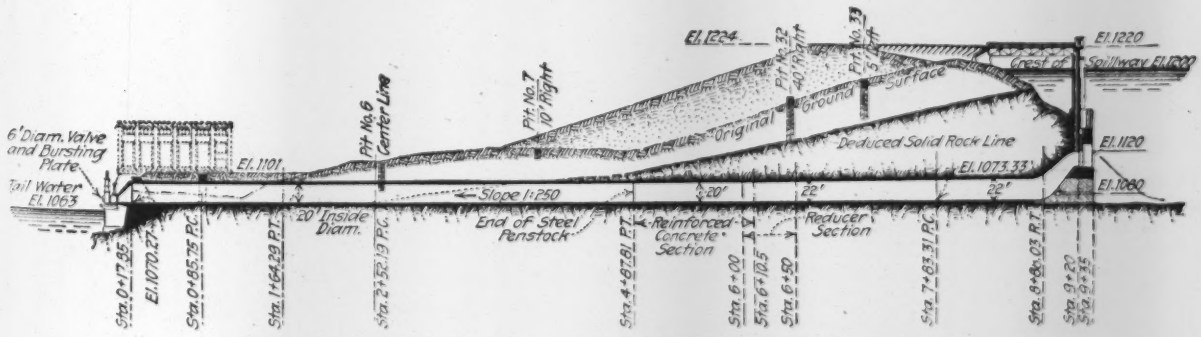
The weight in the air of each of the concrete filled steel headgates is 60,000 lb. This weight is, however, by far not sufficient to lower the gate completely in place, assuming the case that the water is rushing through the intake openings at a velocity corresponding to a 100 ft. head, which will exist in the reservoir at highwater stage. This severe operating condition was specified for the design of the headgate hoist apparatus. On top of the tower, the housing for the 75 hp. motor and the line shaft drive are placed. On the deck provided 12.5 ft. below the top of the tower, the ball race thrust bearings engaging the three pair of 6 in. diameter gate stems of 88 ft. 11¼ in. length, each, are located. Each gate stem is built up of four pieces of cold rolled steel shafting and the 18 ft. long portion of the upper piece is provided with left and right hand Acme threads, respectively. Cast together with the uppermost cast steel coupling is a 17 x 10½ in. flat top which will bump against the bottom flanges of the 24 in. I beams, supporting the thrust bearings, in case the head gate should overtravel when being raised. To prevent the stems from being subject to buckling when the gate is lowered into position, a ring is fastened to the top of each stem which will come in contact with the revolving bronze stand nut forming part of thrust bearing, before the headgate can strike the stops attached to the bottom of the headgate frames. These mechanical limiting devices were considered to be more satisfactory than electrically operated limit switches. A gate position indicator is provided for each headgate on top of the 9 in. gas pipe encasing the threaded portion of the stem above the cast iron cover protecting the thrust bearing. The graduations giving the gate positions for each ½ ft. movement are painted on the pipe.

The beginning of the tunnel is bell shaped so as to have smooth inflow conditions for the water and to permit the placing of two partition walls which subdivide the intake into the three headgate openings. The entire tunnel is lined with concrete and along the first 230 ft. length it has a horseshoe shaped cross-section of 409.4 sq.ft. free area. Then, in a length of 50 ft. it changes its shape into a circular section of 20 ft. diameter. This transition is made because the solid rock over the tunnel is gradually decreasing in thickness, and a fault line consisting of thin layers of decomposed rock with mud seams and water intersects the tunnel roof about 75 ft. below the beginning of the circular section. To take care of the uplift pressure in the water filled tunnel, considering the extreme high-water stage of the reservoir, steel reinforcement is placed in the concrete lining of the circular section, and the amount of reinforcing steel is gradually increased corresponding to the reduction in height of the decomposed rock and earthfill material above the tunnel roof, until the penstock steel takes up full water pressure.

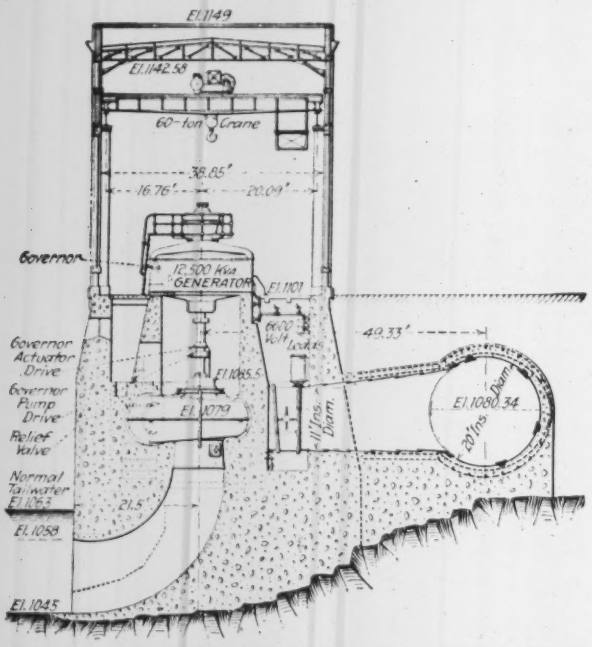


DETAILS OF LINVILLE DAM. ONE OF THE EARTH FILLS, SHOWING ALSO THE POWER HOUSE LOCATION

The penstock of 20 ft. inside diameter is built up of 1 in. plate steel having a tensile strength of from 55,000 to 65,000 lb. per sq.in. and a minimum yield point of one-half of its tensile strength. For the circumferential connections of the courses, single riveted lap joints of 4 in. width are used, and for the longitudinal connections, double-riveted double strap butt joints; the diameter of the rivets is 1¼ in. Stiffening rings made



SECTION THROUGH LINVILLE DAM AT POWER HOUSE AND INTAKE



SECTION THROUGH THE BRIDGEWATER POWER HOUSE SHOWING TURBINE LAYOUT

up of 4 x 4 x ⅜ in. angles are riveted to the outside of the penstock and the average spacing of same is 3 ft. Two branches decreasing from 14 ft. inside diameter to 11 ft. inside diameter lead from the penstock to the power house. The penstock end is formed by a reducer having an outlet of 6 ft. inside diameter. The entire weight of the steel involved in the penstock is 935 tons.

Two 6 ft. diameter gate valves are attached to the reducer in tandem, and a hinged cast-iron head, provided with a nest of seven cast-iron bursting plates of 0.391 in. thickness over an 18 in. diameter area, each, is bolted to the discharge flange of the gate valve, furthest downstream. The bursting plates are designed to give way at a pressure of 80 lb. per sq.in. in the penstock due to waterhammer, and with all seven plates blown out, the discharge of water will be sufficient to prevent further rise of pressure in the penstock and turbine casing. It is, however, figured that this condition will only exist in case the two turbine relief valves should become stuck and would not open.

The entire 20 ft. inside diameter penstock is enclosed in concrete of 2 ft. minimum thickness and covered with earth. At the downstream end a heavy concrete wing-wall connecting with the powerhouse substructure is built. No provision for any expansion joints in the penstock is made.

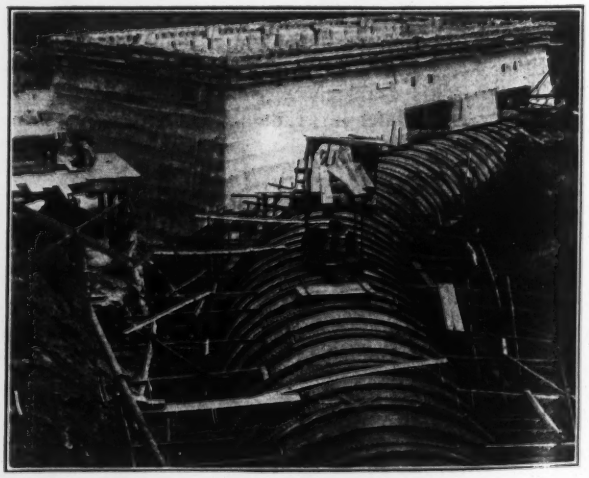
Power Station.—The excavations for the powerhouse substructure are carried down to solid bedrock. The generator floor is at El. 1,101 which is 38 ft. above the normal tailwater level and 56 ft. above the bottom of the draft tube outlet. The height of the substructure which consists of concrete masonry was principally determined by the record flood of July 16, 1916, when the highwater level at the powerhouse site, due to back water from the Catawba River, was at El. 1,090.6. The basement openings through which the ventilating air for the generators passes, are provided with heavy window sash and wire mesh glass. The generator floor system is built of reinforced concrete.

In the powerhouse superstructure red brick encases the structural steel frame supporting the roof trusses and the runways for the 60-ton electric crane. The window-sills and lintels are of concrete strengthened by steel bars. The roof consists of cement tile which is covered with pitch, tarred felt and cinder concrete.

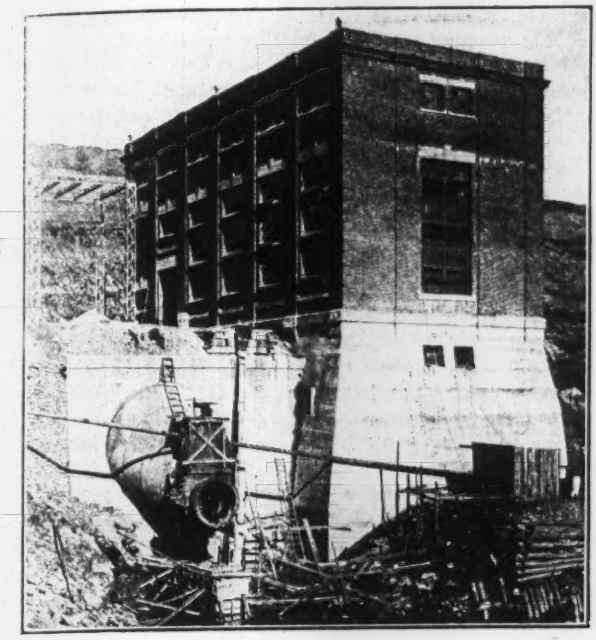
The two turbines installed in the power station are of the Francis, vertical shaft, single runner, volute casing type, operating at a speed of 171.5 r.p.m. Each machine is guaranteed to deliver 13,200 hp. to the generator shaft when operating under an effective head of 115 ft. with an efficiency of 85 per cent. The range in head on these waterwheels will be from 135 ft. to 85 ft. depending on the reservoir stage. The maximum output of each turbine considering the limits of head of 135 ft. and 85 ft. will be 16,800 hp. and 8,000 hp. respectively; above an effective head of 115 ft. the turbine gates will be, however, blocked so that the power developed will not be greater than that corresponding to the rated output of 10,000 kw. of each generator.

The turbine casings are of cast iron and were subjected to the hydrostatic pressure of 95 lb. per sq.in. in the manufacturer's shops. Between each penstock branch and turbine casing a hydraulically-operated butterfly valve is inserted. The lens shaped valve disk is made of cast steel and has a diameter of 11 ft. The operating cylinder is suppled with oil taken from the governor system under a pressure of 150 lb. per sq.in. A locking device is connected with the operating cylinder, by means of which the butterfly valve may be kept in a closed position without the use of oil pressure. The minimum time required for completely closing the valve is 15 seconds, thus preventing an excessive rise of pressure in the penstock in the event that the pressure piping to the cylinder should break.

The governor system for the two turbines is interconnected and the rotary oil pumps of 125 gal. per min. capacity, each, have mechanical drives. Each turbine is provided with a governor operated relief valve having an opening of 4 ft. 6 in. in diameter between the turbine casing and the relief valve elbow and a discharge opening of 5 ft. 6 in. in diameter below the relief valve. On the basis of the normal head being 115 ft. and full load suddenly thrown off one unit, the relief valve will discharge 35 per cent of the water capacity of the wheel. The governor is adjusted to close the gates in 3.5 sec-



POWERHOUSE FOUNDATION AND 20-FT. PENSTOCK



PENSTOCK REDUCER WITH 6 FT. VALVE AT POWERHOUSE

onds, and the guaranteed speed regulations based on a fly wheel effect of 3,360,000 lb.-ft. squared in the rotor of the generator and on the dimensions and lengths of the tunnel and penstock are:

	LOAD ON				
Percent load changes	10	25	50	75	10
Percent speed changes	1.5	3.6	8.0	15	3
	LOAD OFF				
Per cent load changes	10	25	50	75	100
Per cent speed changes	1.8	3.8	9.0	16.8	34

In view of the fact that the load taken up by the Bridgewater Station is only a small portion of the load on the entire system of the Southern Power Co., these regulating conditions are considered satisfactory.

The draft tubes are built of concrete, the upper portion is, however, lined with $\frac{3}{8}$ in. thick plate steel and the draft tube ring connecting with the speed ring is built of cast iron. The water discharges from the draft tubes into the tailrace blasted out of the bed of the Linville River.

A description of the methods used in building the earth dams is contained in a subsequent article.

The complete Bridgewater project was executed under the direction of W. S. Lee, vice-president and chief engineer of the Western Carolina Power Co. Albert S. Crane of the J. G. White Engineering Corporation was retained as consulting engineer in connection with the design and construction of the earth dams and masonry structures, and F. H. Cothran was the resident engineer. J. B. Duke is the president of the company.

Tunnel 484 Feet in 432 Hours

Tunneling progress of 484 ft. in 432 hours working time was made last October in the 8 x 8 ft. drift of the Holmes mine, one of the Cleveland-Cliffs Iron Co.'s properties situated at Oshpeming, Mich. The rock was diorite, hard and dense. Drilling per round required from 17 to 19 holes aggregating more than 100 ft.

Asphaltic Concrete Roads as Built in California

"Black Base," With Bitulithic Topping, Laid on Compacted Adobe Soil Gives Long Service Even on Heavy Traffic Routes

By C. S. Pope
Consulting Highway Engineer, San Francisco, Cal.

While the use of asphaltic concrete for pavement bases has been a more or less well-established custom in California for a great many years and is today in use in more than fifty of its municipalities, yet it is a fact that text books which are recognized as authorities on paving and highway construction give scant or no consideration to this very useful type of base, a condition due, no doubt, to the fact that most of our text books are written by Eastern engineers, whose experience has been largely confined to Eastern conditions and practices. The lack of recognition by Eastern engineers is, of course, also influenced by the fact that this type of pavement has been considered uneconomical because of the high price of the cementing material.

A true asphaltic concrete, often called "black" base to differentiate it from hydraulic-cement concrete or "white" base, is composed of asphaltic cement, a proportion of fine mineral aggregate passing a $\frac{1}{4}$-in. screen and a proportion of coarse mineral aggregate approximately double the quantity of the fine aggregate ranging in size from that rejected by a $\frac{1}{4}$-in. screen to that passing, say, a $2\frac{1}{2}$-in. mesh. All of the above material is heated and plant-mixed.

That part of the City of Los Angeles specifications governing the laying and rolling of asphaltic concrete is given below:

Laying—The mixture shall be hauled to the street in canvas-covered wagons or trucks and shall have a temperature when it reaches the street of not less than 225 deg. F. The mixture shall be dumped on metal platforms. It shall then be uniformly spread upon a subgrade here with hot shovels or forks to such a depth that after rolling to its ultimate compression it will have the thickness shown upon the cross-section. The surface must be smooth and uniform, corresponding with the elevations required by the plans.

Rolling—After the base has been spread it shall be immediately and thoroughly rolled with a roller weighing not less than 8 tons and having a weight of not less than 210 lb. per linear inch width of tire. While still hot the entire surface of the base shall be re-rolled with a roller weighing not less than 12 tons and having a weight of 400 lb. per linear inch width of tire. The rolling must be continued until no movement is perceptible. Any portions of the base not absolutely unyielding under the roller must be removed and replaced. The specific gravity of the base when rolling has been completed shall be not less than 88 per cent of the specific gravity of the combined stone and sand contained in the base.

Protection—The base shall be kept barricaded until the wearing surface is laid.

The result is a firmly compacted base, both solid and waterproof, but to a certain extent flexible, so that any slight settlement does not affect its cohesion, supporting power, nor the adhesion of the surface course. A rational use of this base, as in any other type of base, would contemplate its construction on a subgrade of normal firmness, or that after proper compacting, will remain firm.

It must be remembered that the greatest single enemy of the asphaltic construction is water, either in the subgrade or in the base itself. The water may usually be excluded from the subgrade, but there are certain conditions where this can only be done at prohibitive expense. It is necessary in such a case, and advisable in all cases, to prevent capillary infiltration of water, either by laying a thin course of stone or gravel without filler on the subgrade to break up any capillary action or to lay so dense a base that it is practically impervious to moisture.

Asphaltic concrete bases used to be constructed of poorer materials assembled in a coarser grading with less asphaltic cement and less care in the mix than was given to wearing surface. There is an increasing tendency, however, to make the mix of the base as carefully as that of the surface and especially to secure a water resisting mixture. Also, as it is apparent that the conditions to be met by the base as regards displacement are different and not so serious as those to be met by the wearing surface, it is both possible and desirable to increase the percentage of asphaltic cement.

Base Laid With Varying Thickness

It must be borne in mind that this base is practically waterproof and that a subgrade normally stable will not change through surface infiltration, though it may be ruined from side infiltration, as for instance through irrigation.

The base has been laid of varying thickness—from 2½ in. to 5 in.—but in general it is not considered good practice to lay a base more than 3½ in. thick in one course, because the chilling of the mixture may prevent the necessary compression being obtained.

This base may be surfaced with asphaltic concrete of the bitulithic type, sheet asphalt or topeka, the first being the most generally used and giving great satisfaction. For California conditions, there is no question but that this type of construction is well adapted not only to city streets, but to use in highway construction, and has proved both adequate to the traffic and economical in construction and maintenance. This is particularly true where the soil is adobe or heavy loam. It is quite essential that asphaltic concrete bases be kept as dry as possible making it often desirable to lay a light compacted layer of broken stone or gravel before laying the base, to break up any tendency toward capillary saturation.

One of the earliest examples of this type of construction in central California is at Visalia; a pavement laid in 1896 and subjected to the continuous mixed traffic of medium intensity. It still presents a first-class appearance. As originally constructed it consisted of a 4-in. base composed of gravel, sand and refined asphalt, all plant-mixed, with a 2-in. wearing surface.

Use on Heavy Traffic Routes

In the city of Los Angeles, Lake Shore Avenue is a typical example of the best type. Another Los Angeles example is a street at San Pedro leading to the government harbor fortifications. This pavement is a 3-in. asphaltic concrete base with a 2-in. Warrenite wearing surface, all laid on well-rolled adobe soil. In addition to normal traffic, this paving was, immediately after completion, subjected to the hauling of some 30,000 tons of building material for the fortifications, most of which was carried on 5-ton trucks. Later, the 14-in., 60-ton coast defense guns were hauled over this pavement, which now is in good condition.

While many cities of the State have used an asphaltic concrete base construction, it remained for Kings County to show most strikingly its faith in this type.

Kings County, occupying very largely the old bed of Tulare Lake, possesses wonderfully rich soil, but in some cases the ground water comes right up to the surface. Despite this condition the county constructed its highway system of 4-in. asphaltic concrete with a small amount of thicker pavement. This highway was begun in 1916 and finished in 1918 at about the same time that the concrete state highway, 4-in. in thickness, was constructed through this county. Its total length amounts to 103.8 mi., of which by far the larger portion consist of a pavement 16 ft. in width, composed of an asphaltic concrete base 2½ in. thick, and a wearing surface 1½ in. thick. Maintenance of this road averaged $381 per mile in 1918 and only $8 per mile in 1919. Repairs are concentrated on short sections.

This is, of course, an extremely light construction, and considering the saturated conditions of soil over certain parts of the county covered by the road system, use of so light a type might be criticized.

Failures Due to Poor Drainage

While it is true that certain small portions of this road have failed entirely, failures occurred only on sections subject to saturation from ground water. Greater experience would have caused the engineers to reinforce during construction sections that failed, with a sub-base of rock or gravel sufficient to maintain a solid foundation. The failures serve to illustrate, first, the folly of specifying a standard type of construction for an entire road system—where it can be noted that conditions of soil and traffic are not uniform in all sections of the system—and second, that certain discretion must be exercised by the engineer on all successful construction.

Other advantages of the "black base" which are of considerable importance are as follows:

(1) Bases may be thinner than hydraulic cement concrete and yet not crumble.

(2) The base is flexible and therefore not easily shattered by general settlement, as in the case of fills or adobe soil. The base is always in contact with the subgrade, a condition which does not obtain with a rigid base.

(3) Depressions may be filled up without renewing the base, by simply adding a patch to the surface.

(4) There is perfect adhesion between the base and the surface.

(5) The completed pavement is a tough elastic sheet, well able to absorb shock.

(6) The pavement is waterproof.

(7) The paving is easier riding, not so hard on horses, and presents a pleasing appearance.

(8) The pavement will not buckle during hot weather, and if properly surfaced is unaffected by heat or cold.

New York State License Fee

The license fee for professional engineers in New York State, according to the bill signed May 14 by the Governor is $25. The amount of $35, noted in the news section of this journal May 20, p. 1031, is the combined fee for an engineer and land surveyor.

Alkali Damages Part of Winnipeg Concrete Aqueduct

Four-Mile Stretch of Pressure Pipe in Red River Valley to Be Underdrained to Carry Away Damaging Alkali Water

CONTRACTS are soon to be let for the underdrainage of 1½ miles of the Winnipeg Aqueduct, which was completed last year to carry the water supply of the city of Winnipeg from Shoal Lake, 97 miles away. This stretch of the aqueduct is part of a four-mile section of 8 ft. concrete pressure pipe in the Red River valley near the city, all four miles of which is eventually to be drained in the same fashion as a measure of protection against the alkali ground water which is slowly destroying the texture of the conduit concrete.

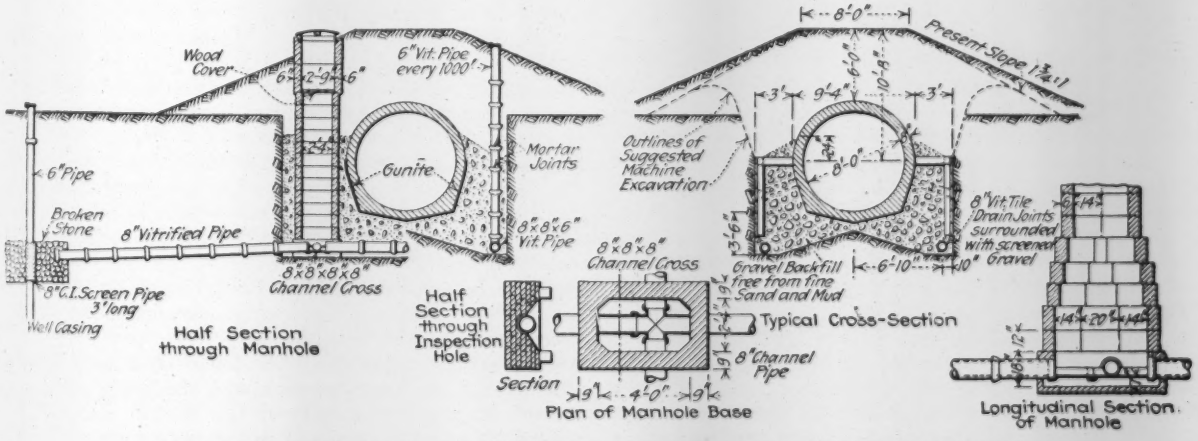
There have been alkali troubles of the concrete in and around the Winnipeg district for some years, and investigations under governmental jurisdiction are now under way. The result of the studies is that while there may be methods of producing the concrete and of protecting it which will render it safe against the attack of the alkali, the best precaution is to divert the ground water from the concrete by drainage. Such underdrainage was provided in the extreme westerly 12 miles of the aqueduct, which part is built of precast reinforced-concrete pipe. The next adjoining four miles of inverted siphon, crossing the Red River valley, built of 96-in. conduit poured in place in the trench, was not underdrained and here the softening of the concrete by the soil alkali was observed to have begun about a year ago, the pipe then being about 2½ years old.

Consequently, the chief engineer of the Greater Winnipeg Water District, W. G. Chace, recommended to the Administration Board of the district that these four miles should be uncovered and then backfilled with gravel, in which would be laid below the pipe two lines of outletted vitrified tile. This recommendation was referred to a board of five engineers, four of whom confirmed his recommendation and further advised that the pipe be undermined and underpined with gravel. One of the five engineers considered that there was no need of alarm regarding possible alkali disintegration. At any rate, the Administration Board followed the lead of the chief engineer and four consulting engineers and ordered tenders for the underdrainage of 1½ miles of the four-mile section.

The accompanying drawing shows the nature of the work to be undertaken. A conduit of 8 ft. circular interior diameter and 8 in. walls with circular arch and trapezoidal inverts, was built in an open trench and backfilled to a height 8 ft. above the outside crown of the conduit. The underdrainage work now contemplated consists in completely uncovering the pipe and excavating to a depth of 2 ft. 8 in. below the lowest part of the invert, that depth of excavation to be only at the sides of the trench with a rise in height of 2 ft. at the center of the trench under the center of the pipe. On either side of the trench are to be laid lines of 8 in. open joint tile underdrains and backfill is then to be carried up somewhat above the center line of the pipe with a gravel free from fine sand and mud. The upper part of the fill is then to be completed with the original backfill, using all surplus excavations to flatten out the original slope.

At intervals of 1,000 ft. are to be vertical inspection holes of 6-in. vitrified pipe with mortar joints rising from the drain tile, and at every mile there is to be a pipe connection across the trench to the drain on the opposite side and a transverse line of 8-in. pipe to a drainage well off line of the aqueduct and beyond the backfill. The wells are to be located where ground water is at least 15 ft. below the surface, so that it can be assured that the drainage from under the aqueduct will pass off. They are to be drilled until a supply of water is reached from which 5,000 gal. per day can be pumped without lowering the level of the water in the well more than 10 ft. After each well has been driven to a depth of 50 ft. it is to be tested for water-flow capacity, and if the specified flow be found the well will be sunk no lower. If sufficient flow be not found the well must be sunk another 20 ft. or until there is reason to believe that within less additional depth a sufficient increment in capacity shall have been struck. The testing and sinking is to be repeated until enough water capacity is found or the well proves dry at the depth possible to drive within the casting started.

At the junction of each cross drain with the longitudinal drain on the well side there will be a manhole made up of superposed concrete rings. At the bottom of this manhole the crossing is made of channel pipe to make cleaning out easy.



METHOD TO BE ADOPTED IN UNDERDRAINING WINNIPEG AQUEDUCT IN ALKALI SOIL

Precautions are to be taken in the excavation not to damage the structure of the conduit. When the conduit is laid bare it is to be examined carefully for alkali disintegration, and if any softening is found the surface is to be cleaned with chisels or scrapers and then sandblasted as thoroughly as practicable. The surface then is to be given a coat of portland cement mortar with a cement gun to a minimum thickness of ½ in. Side braces of timber, as shown in the drawing, are provided to hold the trench in place during excavation and cross-struts placed against the pipe. These are to be left in place in the fill.

The work is of considerable extent, including according to the estimate of quantities for every mile of conduit 200 ft. of well drilling, 42,000 cu.yd. of earth excavation and backfill, 11,000 lin.ft. of 8 in. vitrified tile, and 12,000 cu.yd. of gravel backfill.

Community Service Applied to Highway Construction

By William W. McClendon
City Engineer, Mineral Wells, Tex.

Mineral Wells, a town of 10,000 population, is situated in Palo Pinto County, 54 mi. west of Fort Worth and in the heart of the West Texas Oil field. Due to its proximity to oil fields, highways connecting it to other points in the county have been subjected to immense increases in motor and freight traffic. The 35-mi. stretch of road leading from Mineral Wells to the Stephens County line is now subjected to an average of 67 vehicles per hour for a period of 10 hr., of which traffic 45 per cent is truck, the average load, excluding truck weights, being five tons.

Due to the fact that this immense increase in traffic has been imposed almost overnight, so to speak, the maintenance fund which the county has had to spend on this road has long since been exhausted and the roads have become almost impassable.

The citizens of the town and members of certain oil concerns raised $10,000 to be spent toward permanent improvement on this road, which sum was augmented by a like amount from the county and $20,000 from the State Highway Commission. It was agreed that this money be spent on the road west of the town of Palo Pinto, the county seat, 13 mi. west of Mineral Wells.

Due to the mountainous character of the country where this $40,000 was to be expended in permanent improvement, it was found that the first 10 mi. would be so heavy that even the sum of $40,000 would be exceeded. The drainage structures alone averaged 3½ culverts and two bridges, of not less than 20-ft. span, per mile. Plans and estimates were prepared showing that the permanent construction would be limited to a 4-mi. stretch.

A canvass of the county indicated that sentiment was against a county bond issue for the road improvement and an investigation made to see if it was not possible to form a shoe-string road district and vote bonds for the improvement of the road proved legally impossible. A plan was then originated by the Mineral Wells Chamber of Commerce whereby citizens of that town and inhabitants along the road take the improvement of the road into their own hands. A canvass concerning this plan showed it favorable. Accordingly a committee on arrangements was organized and a definite day was set upon which all business houses were to close and every one was to turn out to work on the improvement of the road. A log of the 35-mi. stretch was made and the condition of the road, indicating needed improvements, was recorded in detail. Blueprints, each representing a mile of road, were made and distributed to captains in charge of gangs who were to improve their particular mile of road. Locations of material piles were noted as well as bad spots in the road. Sheets also carried the information as to the exact number of men, teams, trucks, picks and shovels necessary to build that particular mile of road in one day.

The committee then secured a tabulated list of all available men with their addresses and phone numbers, as well as the list of teams, trucks, picks, shovels, etc., available. The day on which the road was to be worked was postponed several times because of inclement weather, but on Nov. 21, 1919, the big working day came. The writer with his partner, A. B. Purnell, acted as general supervisor over the entire 35-mi. stretch, assisted in keeping things moving and offering suggestions wherever needed. All business during the day was suspended and the full organization as originally planned and which turned out, consisted of the following: 1,270 men, 1,000 picks and shovels, 175 trucks, 110 teams, 3 tractors, 4 graders and 6 road drags, post hole diggers, sledges, etc. The road was put in excellent condition for the entire 35 mi. and now 10-ton truck loads that formerly found an impassable road find easy traction. Twelve new culverts and eight new bridges were put over creeks where formerly there had been nothing. As an example of the celerity with which the men worked one section containing 20 carpenters under the captaincy of a local contractor tore out and built a new 10-ft. span bridge 6 ft. high and 18 ft. wide in 1½ hr., that time including even the time employed in filling bridge approaches. The same procedure is contemplated in the improvement of the road leading north from the city and the same committee has been appointed to formulate the plans for this construction.

Taxation on English Motor Vehicles

According to an editorial recently appearing in the *Engineer*, a change is contemplated in the method of taxing motor vehicles in England. Heretofore, the revenue has been obtained from two sources; a graduated tax on private vehicles and a tax of sixpence per gallon on gasoline. It is now proposed to do away with the latter and place a much higher tax on the vehicle. One pound per horse power has been suggested, which would mean in the case of most cars, a tax of between three and four times that at present in force. That the *Engineer* believes such a tax inequitable is apparent in the following: "On the suggested horsepower assessment alone, the tax on a Ford would be out of all reason compared with that of a Rolls-Royce; while if the wear and tear of the roads is considered, the difference in the weight should enable a lighter machine to escape with a much more relative impost. We should suggest, therefore, that the taxation of private cars and commercial vehicles alike should be based on some formula which takes into consideration both the horse power of the engine and the weight of the vehicle, as by that means the taxation imposed would bear some relationship to the wear and tear inflicted on the roads surface.

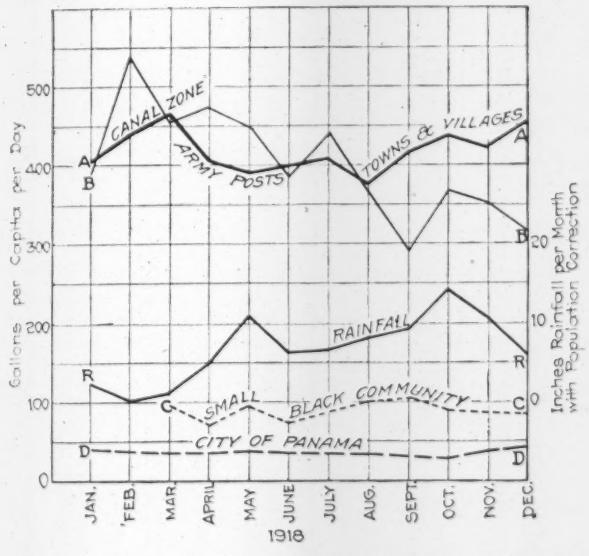
Per Capita Water Consumption in the Canal Zone and City of Panama

By R. C. Hardman

Engineer-Designer, the Building Division, Panama Canal

STUDIES of the per capita water consumption for the calendar year 1918 in the Canal Zone and in the City of Panama, Republic of Panama, reveals some very interesting data concerning the effect of a tropical climate and different environments and social conditions.

The population studied can be roughly divided into three classes—American, West Indian and Panaman—and the lines between the three are drawn rather sharply, both from a social and a geographical sense. Therefore it is comparatively easy to differentiate between them in a study of this nature, which is here presented by curves A to D, showing the daily per capita consumption by months.



WATER CONSUMPTION AND RAINFALL IN THE CANAL ZONE AND THE CITY OF PANAMA

A. This curve represents the Canal Zone population of the principal towns and villages and covers 16,450 men, women and children, both white and black. Of these 5,834 are American employees and their families and 10,616 are black West Indians. The American employees live in free quarters, while the blacks pay a nominal rental, but all are supplied with water free of cost to the individual. Every facility is offered both black and white for bathing, shower baths being installed profusely. The industrial uses of water are not numerous or large. The standard of living among the American employees is high, as all are highly paid, while that of the West Indian is higher than usually found among labor of this nature, as the occupants of Canal quarters are the better-paid and more nearly permanent employees.

B. The Army posts studied contained an average population of 2,778, who live under practically the same conditions as the American employees under A.

C. This curve represents one black community which is entirely isolated and contains no industrial uses of water except a commissary and clubhouse. The population is 1,663 and has also been included in curve A. The bulk of the population lives in quarters housing 12 families with one house holding 48 families.

D. The city of Panama has a population of 61,074, mixed in color and social status, but with white in the small minority and blacks in the majority. The living conditions among the poorer classes of blacks and natives are execrable. All water services are metered, the water rate being 35c. gross and 25c. net per 1,000 gal. Adequate facilities for bathing are not to be had as on the Canal Zone.

The above explanations, it is believed, will be sufficient to make plain the different social orders, and the reasons for the great variations in consumption.

The population represented by curve A is divided into two portions with different percentages of whites and blacks. One portion has a black percentage of 78 and the other 59.5 per cent. The portion having 78 per cent shows a daily average for the year of 51 gal. per capita less than the one more nearly white.

Curve C shows the consumption in a "black" town with no industrial uses to be somewhat less than 100 gal. per capita. A similar community of Americans, with no industrial uses, shows a consumption of 288 gal.—practically treble that of the blacks. (The record is for four months only.)

In an attempt to ascertain how much of the consumption was for strictly domestic uses and how much industrial and irrigation, a number of family and bachelor quarters were metered in the Canal Zone. The results were so at variance, ranging from 72 to 302 gal. for family quarters, with an average of 161, that no dependence could be placed upon them. A female bachelor building showed 446 gal. and male bachelors but 241 gal. The per capita consumption of all individual quarters metered showed an average of 278 gal., which checks very closely with the 288 gal. mentioned in the preceding paragraph.

The results of the study are that the average consumption for all purposes on the Canal Zone is about 400 gal.; that for American domestic use is 300 gal., and that for West Indian employees is 100 gal. for purposes of estimating. The reasons for the high consumption are (1) the water is free and unmetered; (2) the tropical climate; and (3) the faclities for bathing freely and often.

As an interesting side light, the curve R is plotted to show the relation of rainfall to water consumption. As nearly 12,000 of the population considered lives in a district having a 54.82-in. rainfall and the balance in a district having 125.27 in., a curve having the elements of rainfall and population was evolved. This was done by taking the monthly rainfall in each district, multiplied by the population, the sum of the two products being then divided by the total population. The result gives a sort of "rainfall per capita of population" curve. It will be noted that the water consumption is high when the rainfall is low.

Municipally Owned Paving Plants

According to figures recently compiled by the Milton Hersey Co., Ltd., of Montreal and Winnipeg, there are 72 municipally owned paving plants in the United States. In addition, the United States Government operates 12 plants of its own. Canada and foreign countries have a total of 16, making a total of 100 municipally owned asphalt paving plants in the world.

Engineering Factors in Irrigated Farm Appraisals

Engineer-Appraisers of Federal Farm Loan Banks Have Developed Values in Terms of Adequacy of Water Supply

ATTACHED to every one of the twelve Federal Land Banks whose district includes irrigated or drained lands is an engineer-appraiser with engineer assistants. These engineers are directed so far as the character of investigations and reports are concerned by the Office of the Engineer, Irrigation and Drainage, J. T. Whistler, located in Denver. Assignment to this or that district is left to the banks. Reports are reviewed by the Denver office and the conclusions reached and recommendations made by the engineer-appraisers are approved or disapproved. The banks are authorized to act on recomendations of the engineer-appraisers as soon as reports are made. but any modifications made by the final review supersedes the original conclusions and recommendations. The character of the investigations and the classifications to which the experience of three years' operations have led were given recently as follows in an address of Mr. Whistler before the Idaho Irrigation Congress:

Three principal subjects are considered by the engineer appraisers: Water supply, involving a complete presentation and study of water rights; drainage conditions, and construction, both as to character and adequacy. There are districts, of course, where character of construction will be much more important than the matter of drainage, as for example, where a dam is constructed with inadequate spillway capacity, pumping plants in which the cost of operation and maintenance with depreciation practically absorbs the profits of the farm, or a canyon canal poorly located and maintained, on which perhaps the entire irrigated area depends. On the other hand, there are projects where irrigation construction features are simple and maintenance low, but where adverse drainage conditions have arisen or will arise which may very seriously affect values, sometimes within a few years, sometimes 10 or 20 years later.

The necessity for considering such matters is apparent when it is realized that federal farm loans may run 40 years and are now being made with an amortization period of 34½ years, in which period a comparatively small part of the principal is paid off during the first 10 years.

In addition there is included in the report all general information which may be considered of value to a layman-appraiser following the engineer-appraiser, such as climate including rainfall, topography as affecting a consideration of drainage problems, and also construction and maintenance of ditches, soils, crops, markets, transportation and any history of development which may throw further light on the value of property, such as failure and reconstruction of a dam, financial difficulties, with perhaps failures which may account for an otherwise apparently excessive bonded indebtedness.

Water Supply Classification

In making recommendations it was at first difficult to do so without using expressions of land values to show relative values as affected by the various conditions described. It was desirable that expressions of relative values be not used in the reports, the principal reason being that actual appraisals of individual farms will almost certainly be made by other engineers from time to time, even if some of the first appraisals are made by the engineer-appraiser making the report. It was felt that the report should not influence subsequent appraisers otherwise than by fully presenting conditions and facts. There was finally evolved a system of water supply or water right classification in which all water supplied under the different water rights are divided into the four following classes, without reference to values expressed in dollars but in terms of adequacy of supply:

Class 1. Water supplies which have no shortage during ordinary years.

Class 2. Water supplies which have some shortage in normal years, but which furnish sufficient water to mature crops. Where storage is involved, those providing two-thirds or more of a full supply are in this class if not in class 1.

Class 3. Water supplies which furnish water only during the normal flood season. Where storage is involved, those providing one-third to two-thirds of a full supply.

Class 4. Water supplies which furnish during the irrigating season a full supply for not to exceed 30 days in normal years and none in years of low run-off. Winter irrigation supplies and those providing less than one-third of a full supply where storage is involved.

Construction

Under the subject of construction perhaps the problem which most often adversely affects the value of irrigated lands is that of insufficient spillway capacity from reservoirs the storage water from which may be the principal source of supply to the lands. It often happens, for illustration, that dams have been constructed little by little, the height being increased several times and temporary construction replaced as found necessary by permanent construction, in which altogether the cost of the storage provided may be greater than its value to the irrigated lands. So long as the dam stands, however, the lands have a certain value, even if less than the cost of construction. If the dam as finally constructed is found sound and the spillway capacity adequate the lands under it can be given a value on the conditions existing, regardless of whether the project was financially a proper one in the beginning. If the spillway capacity is insufficient and the dam should go out with a flood, it is clear that such a dam would probably not be reconstructed and the security afforded by these lands would, of course, then be little or nothing.

In less flagrant cases of ill-advised construction, the loans under a project might be such that in time something approaching half the interest in the lands of the project would be held by one of the banks through mortgages by the borrowers. Should an important structure such as a dam fail, it is not inconceivable that the borrowers might say "Our real interest in the project is not sufficient to justify our again expending the amount of money which it will cost to replace the dam," and the bank might be called upon to assist because of its interest in the lands.

Drainage

Perhaps the greatest uncertainty connected with the engineer-appraiser's work is that relating to drainage. As is well known, many lands, which ten years ago were free from drainage troubles and without suspicion of adverse conditions arising, are today badly alkalified and are often waterlogged. Engineers of the Agricultural Department engaged in drainage investigations would have been laughed at if they had advised that drainage would ever be needed, and yet today the lands may be producing little or nothing. In most cases it is a matter of $25 per acre to provide drainage. Reclamation of the alkalified lands is another matter and, depending on the character of the alkali salts and of the soil, this reclamation may cost more than the lands will be worth when reclaimed. It is the duty of the engineer-appraiser to anticipate these conditions so far as possible.

Dry Dock Three Ships at Once at Panama

Full use was recently made of the large dry dock at Balboa, C. Z., when three ocean steamers were docked in it at one time. A view of the dock with the three ships in it was published in the "Panama Canal Record" of May 12, 1920. The ships were respectively 262 ft. and 2,939 gross tons, 261 ft. long and 2,482 tons, and 445 ft. long and 7,059 tons. The total length of the three ships was 968 ft. The dry dock is 1,000 ft. long and 110 ft. wide.

Ease of Operation Governs Design of New Seattle Pier

Experience on Similar Adjacent Pier Led to Different Shed and Track Arrangement and Special Crane

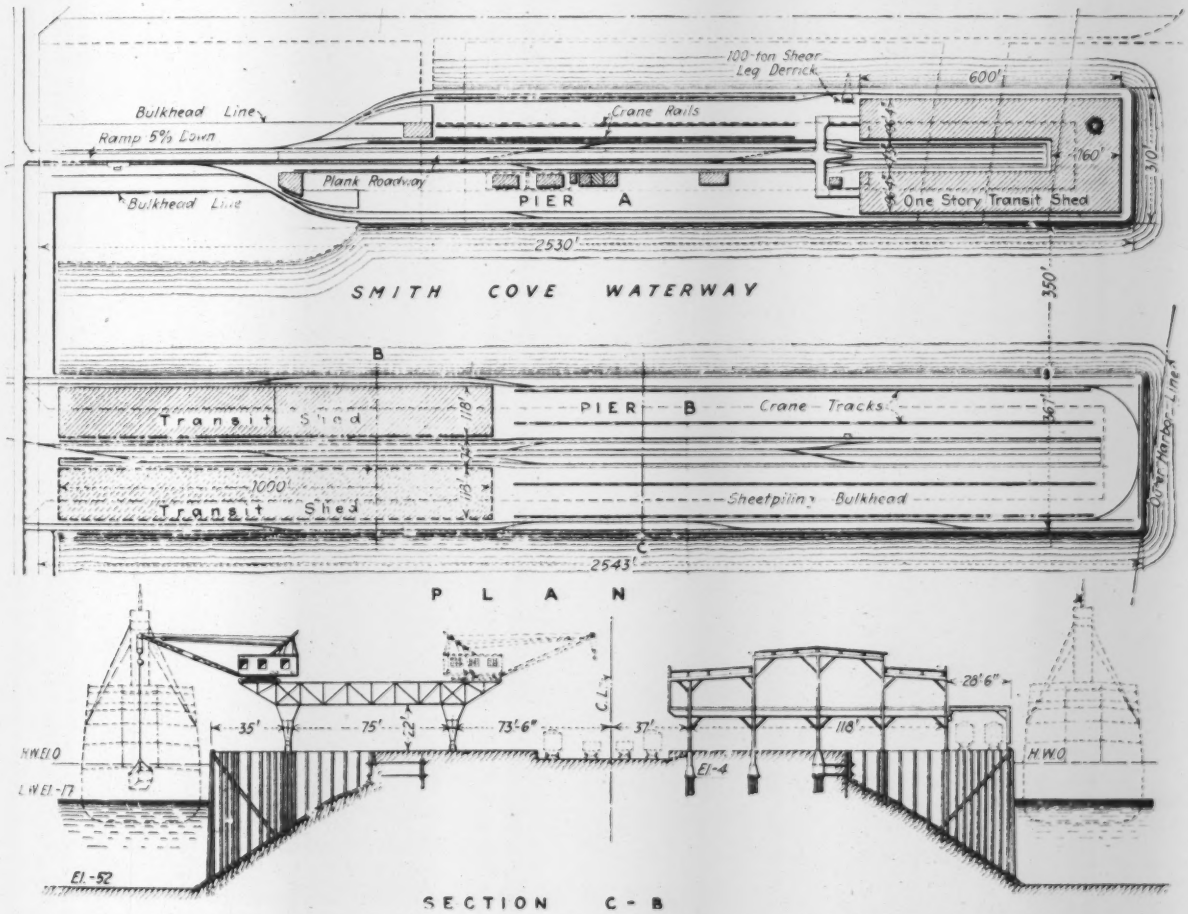
By George F. Nicholson
Chief Engineer, Port of Seattle

For five years the Port of Seattle Commission has operated the municipally owned Smith's Cove Pier A (310 ft. wide by 2543 ft. long) and in that time has accumulated a store of information of value in designing the adjoining pier of similar size now under construction. The Commission's experience has been the more valuable because of the very heavy traffic in recent years over existing facilities in close proximity to the old pier. In 1918, for example, 808,000 tons of freight were handled over Pier A on which the Commission made a net profit of $378,000. The freight passing over Pier A in 1919 totaled 1,100,000 tons.

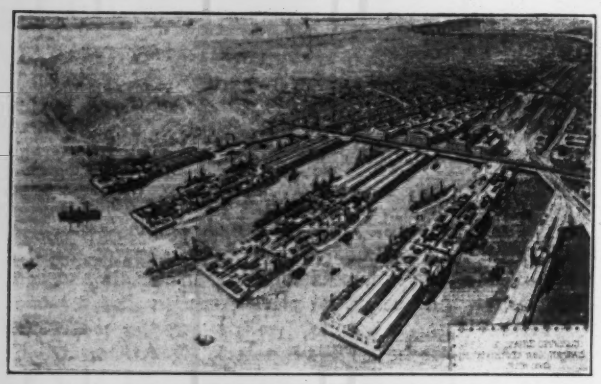
Pier A, which was described in *Engineering News*, March 11, 1915, p. 476, has accommodated six large deep sea vessels, all of which were loading or discharging freight simultaneously. Under traffic conditions of this sort it has been possible to make a thorough and careful analysis of the track and shed arrangement and equipment in use on this pier. When the time came to begin construction on the pier adjoining not only was this experience carefully reviewed but the Port Commission sent its engineer on a tour of inspection including every important port of the United States so that a study might be made of ideas and improvements which have succeeded elsewhere.

The new unit, Pier B, is 365 ft. wide and 2,560 ft. long, and when completed will cost $2,500,000, an increase of about $1,000,000 over the cost of Pier A. This is due to the increased cost of materials and labor and larger and better equipment on Pier B.

As shown in an accompanying view, the central 215 ft. of Pier B is being filled in solid, the material being pumped by suction dredges from the slips alongside the pier. This fill contains about 1,000,000 cu.yd. (Another 1,000,000 cu.yd. is being used to fill a waterfront street connecting the Smith's Cove Terminal with Seattle's business district.) The 75-ft. wharf along either side of this central fill on the new pier makes it possible to maintain a 35-ft. depth of water at low tide without the use of a retaining wall. As the tidal variation here is 17 ft. there is a total of 52 ft. of water at high tide alongside the pier. The 1½ to 1 slope from the top of the fill to the channel bottom is covered by a 2 to 3-ft. thickness of rock placed to protect it from wave action. The wharf is constructed entirely of creosoted piles and timbers, a total of 12,000 piles being used.



LAYOUT OF OLD PIER "A" AND NEW PIER "B" AT SEATTLE'S SMITH COVE DEVELOPMENT



GENERAL VIEW OF SMITH COVE TERMINAL, SEATTLE, WASH.

The arrangement of tracks on Pier B was decided upon only after a study of various alternatives. On Pier A the arrangement is two shipside tracks along the face of the dock on the open wharf and one alongside the sheds. Experience with this arrangement indicated that two shipside tracks along the sheds would be an improvement and this plan is being followed on Pier B. The advantage is that in some cases when several boats are being loaded on one side of the pier with export cargo, which is chiefly steel, iron and lumber, it can be loaded directly from car to ship along the full length of the dock.

In addition to these tracks along the face of the dock there are four depressed tracks in the center. On Pier A these were separated by a 20-ft. roadway which was considered necesasry to accommodate the vehicular traffic to and from the sheds on the outer end of the pier. On Pier B, however, this roadway was eliminated by placing the transit sheds at the street or inner end of the pier. Thus the four central depressed tracks were placed together which makes it possible to handle cargo from four tracks to one side of the wharf, should that be necessary. This is a distinct advantage over the arrangement on Pier A.

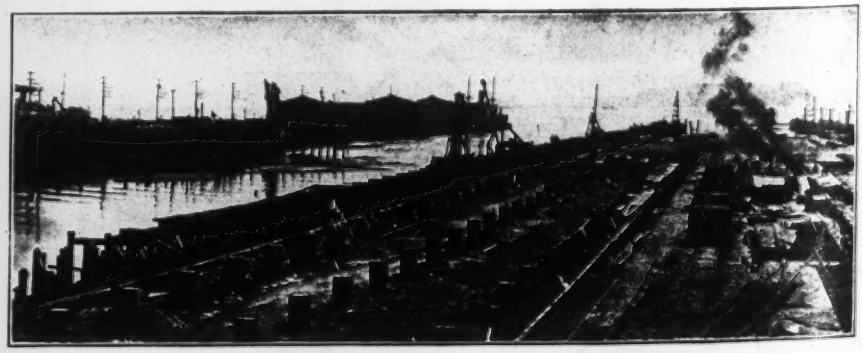
Not all of the crossovers from track to track are shown in the illustrations. On Pier A these were located about every 750 ft. This was found insufficient in working a number of boats simultaneously so in laying out trackage on the Pier B crossovers were provided for about every 450 ft. In order to make it easy to get the switch engines and trains from one side of the pier to the other, a connecting track was laid around the outer end of Pier B on a 133-ft. radius. From this curve there is also a track along the face of the outer end of the pier which can be used in unloading or loading ships and barges that tie up across the end of the pier. Pier B will have a total trackage of 5 miles as against about 4 miles on Pier A.

The mechanical handling equipment on the new pier will consist of two gantry cranes of 12½-ton capacity, one on each side of the open wharf section, and a heavy revolving crane at the end of the pier for making heavy lifts. The latter will have a maximum capacity of 100 tons. Three 35-ton and one 15-ton locomotive cranes will be provided for handling heavy commodities on the open wharf section. There will also be four electric elevators with 10 x 24-ft. platforms for use in the transit sheds. A very complete assortment of light handling equipment will be provided, including electric tractors, trailers, stackers, conveyors, and portable platforms for use with the two-story sheds.

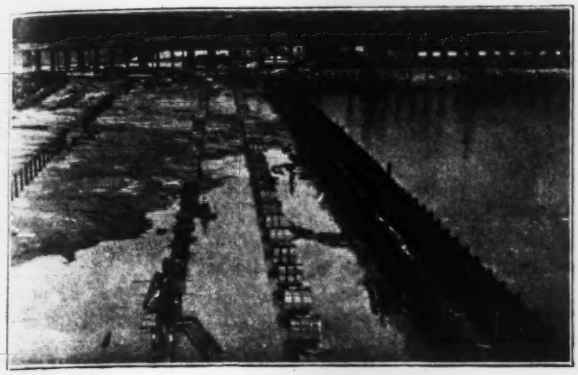
The two gantry cranes being put on Pier B are of a type consisting essentially of a locomotive crane operating on an elevated transfer bridge. This arrangement makes it possible to handle freight to and from cars located on any of the eight tracks in the open wharf section of pier; to and from ships, and also to and from any part of the open storage area of the pier, in one continuous operation. This would not be possible with any ordinary type of crane because of the distance across the pier (205 ft.) that must be covered by the crane hook.

By providing a gantry bridge on which the locomotive type of trolley can be used, greater dispatch and cheaper operation is made possible with a comparatively short boom. The gantry type of crane occupies the least possible storage space, requiring only two narrow tracks of 30-in. gage running longitudinally with the pier. Moreover, it provides a very efficient method of locomotive crane service to every square foot of storage area from or to cars and ships. It has a decided advantage over the surface locomotive crane, in that it is elevated above the storage, cars and ship's decks, and therefore has ample boom clearance at all times.

With the gantry crane used on Pier A, which has a hinged apron that can be raised and lowered, and which operates on tracks close to the outer edge of the pier, there are certain stages of high tide when it cannot be operated without interference with the ship's rigging and booms. Also the hinged apron has to be lowered very carefully between the ship's boom or alongside ship's bridge over the hatch. With the new crane there will be no interference with the ship's rigging at any stage of the tide, so that the crane can be operated the full length of the wharf while the ship is loading or discharging. With the Pier A gantry crane the bracing in the two inner legs of crane interferes with the movement of long sticks of lumber and long bar or sheet steel to and from cars or when loading from wharf to ship. This makes it necessary to raise the load very high under the trolley cage in order to get it clear. With the new



CENTRAL FILL IN PIER "B" AT SEATTLE



FOUNDATIONS FOR WAREHOUSE ON ONE SIDE OF PIER "B"

type of crane there will be no interference of this kind.

The new pier is divided into an open section and a shedded section because the chief import cargoes handled at this terminal are merchandise and boxed and baled goods which need protection from the weather, while the chief export cargoes are steel, iron and lumber that do not need protection from the elements. A ship with an import cargo discharges into the transit sheds and then is warped along the pier to the open wharf section where it takes on its cargo of steel, iron or lumber.

By locating the 120-ft. x 1,000-ft. transit sheds at the shore end of the pier, not only is the need for a roadway on the remaining open section of the wharf removed, but the main office and passenger terminals are located near shore where they are more readily accessible. The passenger accommodations will be on the second floor of the shed, the waiting room being 48 ft. wide and 80 ft. long. Along the face of the pier a portable adjustable ramp will allow the passengers to leave the ship and enter the second floor of the transit shed in close proximity to the waiting and baggage rooms on an easy grade and without crossing any railroad tracks. In fact, with this arrangement the passengers will not cross any roadways or tracks at grade from the time they leave the ship until they reach the street cars and waiting automobiles on the waterfront. The use of an overhead bridge and the Garfield Street viaduct is not only a means of convenience and safety for the passengers by keeping them away from rail and vehicular traffic, but it also reduces the fire hazard and avoids traffic delays. Work on Pier B started in February, 1919, and the construction schedule calls for its completion about July 1, 1920.

New Railroad Line Opened in Poland

The first railway line built by Poland since the armistice has been formally opened for traffic between Kutno and Strzalkow, 111 km., effecting a cutoff of 71 km. in the rail connection between Warsaw and Posen. It was decided in February, 1919, to undertake construction which was begun the following July. Temporary bridges have been used and work is now progressing in building second track and permanent bridges. The new line is intended also to serve as a link in the projected International Transcontinental Railway between Vladivostok, Moscow, Warsaw, Paris and London.

Prices and the Cost of Living

Announcing not only an indefinite continuation of present high prices but a possibility that prices of commodities will rise still higher, Royal Meeker, Commissioner of Labor Statistics, United States Department of Labor, makes the following comment in a recent issue of the "Monthly Labor Review":

If prices are to be lowered, the causes operating to boost prices must be attacked. The amount of money and checks in circulation must be appreciably reduced and the quantities of necessary goods must be increased in amount. The stocks of commodities manufactured on Government account must, so far as is possible, be salvaged and thrown upon the market. The extraordinary demand for goods must be curtailed or the production of these goods expanded.

The financing of the war has made $2 grow where but $1 grew before. This, coupled with the fact that there has been an enormous destruction of economic goods and of the farms, mines, forests, and factories supplying these goods, explains the enormous and world-wide decrease in the purchasing power of money which causes increased prices. As long as the people have twice as many dollars with which to buy a smaller number of commodities, prices are bound to remain high. It will take a long time to deflate the world's inflated currencies or to inflate the world's deflated supply of goods. The profiteers are being blamed on all hands for the increased prices. Undoubtedly, profiteering of a most reprehensible sort has existed and does exist today, but the profiteer is a result of ever increasing prices rather than a cause thereof. His influence in boosting prices is negligible. If all the profiteers in the world could be apprehended and thrown into jail or lined up and shot, it would have no appreciable influence upon prices.

It has been suggested that the abnormally high prices are psychological in effect, and that prices will fall just as soon as the people can be made to think falling prices. Of course, psychology is involved in every price, but the larger quantities of currency, and the smaller amount of commodities are typical facts that no psychic legerdemain can overcome.

I see no prospect of any considerable fall in prices for several years to come. It will be impossible for the governments of the world to pay off their debts very rapidly. On the contrary, there is every reason to apprehend that credit must be issued to foreign government, foreign manufacturers and foreign business men in order to rehabilitate the broken and shattered industries of Europe. This being the case, we may expect that larger volumes of checks and credit instruments will be thrown into circulation, thus boosting the prices still higher.

Some business men are apprehensive lest the United States be flooded with European made goods which will bring prices tumbling down. The price of foreign exchange at the present time is such as to make it highly profitable for American business men to buy large quantities of goods in Europe, especially in Germany and Austria, if European countries only had the goods to sell. Not until Europe has rehabilitated its industries may we expect to have our markets flooded with European goods.

Production should be speeded up to the limit, and debts should be paid not with more debts but with economic goods and services. These processes should be set in motion without delay. It will require several years to readjust industry and trade on a firm basis again. In the meantime, the United States Government should, in my judgment, join with the other leading governments of the world in the creation of an International Commission to study ways and means of setting up a true and relatively constant standard of value to displace the present monetary units which are merely units of words and consequently variable in value or purchasing power. The most important constructive work that can be done in any field, is the establishment of a stable standard of value, so that all the people, rich and poor, employer and employee, bond-holder and stock-holder, may be spared for all time the agonies of changing price levels.

Stray Points in Structural Steel Design—Part II

Friction and Shear in Riveted Joints—Effects of Blind Following of Precedent—A Table of Lattice-Bar Stresses—Light Bracing Struts—Points in Detailing That Affect Design

By R. Fleming,
American Bridge Co., New York City

The Frictional Resistance of Riveted Joints.—Johnson, in his book "The Materials of Construction," writes: "It seems probable that all riveted joints in practice do their work through friction alone, and that in no case are the rivets subjected to either shearing or bearing stress." As long as rivets remain tight this is more or less true; if they become loose dependence must be placed entirely upon shearing and bearing.

Exact values cannot be assigned to the frictional resistance of plates held together by rivets. They are a function of the tensile stress in the rivets due to cooling and of the frictional resistance of the surfaces in contact. The stress due to temperature dropping through a certain number of degrees can be determined mathematically, but this does not solve the problem. Johnson shows that a change of only 154 deg. Fahr. in temperature would bring rivets to their elastic limit if they were not allowed to contract. He continues: "Evidently, therefore, all well-driven rivets in plates which are tightly clamped together when the rivet is driven and so held till the rivet cools are left in a state of tension exceeding their elastic limit. If the coefficient of starting friction be taken at 0.4, and the elastic limit of steel rivets be taken at 30,000 lb. per sq.in. and of iron rivets at 25,000 lb. per sq.in., it follows that the frictional resistance would be 12,000 lb. per sq.in. of rivet section for steel rivets and 10,000 lb. per sq.in. for iron rivets, in lap-joints, and twice these amounts for butt-joints with two cover plates."

An article, "Experiments for the finding of strains in material caused by riveting and which may tend to produce flaws in rivet holes," by C. Bach and R. Baumann, in the *Zeitschrift des Vereines Deutscher Ingenieure* for Nov. 23, 1912, describes a set of experiments from which it was concluded that the tensile stresses in ordinary rivets parallel to the shank after they have cooled subsequently to being driven by a hydraulic riveter was about 31,000 lb. per sq.in. of rivet cross-section. A lecture by Preuse on "Experiments in Riveting," reported in the same paper March 9, 1912, p. 404, seems to show that the rivets of a joint act mainly to hold the plates together by friction. This opinion is partially endorsed by Professor Batho in his paper, "The Partition of the Load in Riveted Joints," *Journal of the Franklin Institute*, Nov., 1916, p. 553.

The most available reports of tests to determine the slipping resistance of riveted joints are those in "Tests of Metals," 1882, Watertown Arsenal. Experiments were instituted to determine the amount of friction that is caused from the pressure with which one plate is forced against its neighbor by riveting. Iron and steel plates $\frac{1}{2}$ and $\frac{3}{4}$ in. thick were used, held together first with one and afterward with five iron rivets. Joints were hand-riveted. In general, the tests showed the resistance offered by friction of the steel plates to range from 14,500 to 18,000 lb. per sq.in. of rivet section.

Tests recorded by Dupuy in his memoir, "Upon the Resistance of Rivets," *Annales des Ponts et Chaussés*, 7th Series, Vol IX, 1895, pages 5-107, show the first slipping resistance (as determined by an extensometer) of plates held together by steel rivets occurring at 7,500 lb. per sq.in. of rivet cross-section for hand-riveting, and 10 to 12,000 lb. for hydraulic riveting.

As the plates were butt-jointed the rivets were in double shear and the values given are for each of two areas of cross-section. The values are much lower than might be expected in present practice.

Talbot and Moore in their "Tests of Nickel-Steel Riveted Joints," *Bulletin No. 49*, 1911, of the Engineering Experiment Station, University of Illinois, report: "In the tests there was a noticeable slip of joints generally at loads within ordinary working shearing stress of rivet. * * * All the riveted joints failed by shear of rivets as was to be expected, at ultimate shearing stresses which ran fairly uniform in both the nickel-steel series and the chrome-nickel steel series for all the types of joints tested."

While friction is an important factor in the strength of riveted joints, it is too uncertain to be depended upon, and under shock or vibration may, in the writer's opinion, be destroyed altogether. For this reason connections must be designed using the shearing and bearing values of rivets. Recent specifications and building codes are becoming agreed on allowable working stresses of 12,000 lb. and 24,000 lb. per sq.in. for shearing and bearing values of shop rivets. However, because of the frictional resistance of rivets, there is a tendency to increase these values. The present specifications for steel work of the New York subways allows 15,000 and 30,000 lb. The Carnegie "Pocket Companion" allows 30,000 lb. per sq.in. bearing value for "enclosed" shop rivets in beam connections.

Much has been said about secondary stresses resulting from eccentric riveted connections. Nearly 20 years ago a strict theorist called the attention of the writer to the details of some roof trusses in which according to his calculations rivets were stressed in shearing and bearing far beyond any allowable limits. The usual explanation why these and similar structures are standing is that they have never had the load for which they were designed. It is also brought to mind that shearing and bearing values are based upon the diameter of the rivet before driving while the actual diameter of the rivet when in place is $\frac{1}{16}$ in. more than the nominal diameter. Probably the main reason why connections such as these do not fail is that the frictional resistance of the surfaces brought in contact is sufficient to prevent bending from being developed.

Articles have been written for the purpose of showing that the standard connection angles of beams are weak because of secondary stresses due to eccentricity. Yet the connections are used by the ten-thousand without records of failure. The Carnegie "Pocket Companion" boldly says in the table of the strength of connection angles, "Connections are figured for bearing and shear (no moment considered)."

It is always wise to avoid as far as practicable eccentrict riveted connections. But before condemning ex-

isting structures in which they are found, it should be remembered that there is an indeterminate, yet not to be neglected, frictional resistance of surfaces in contact which tends to decrease the stresses due to bending moment.

Precedent and Originality

The structural designer may at times ask himself: "Shall I follow established precedent, or shall I break loose and be original?" A paragraph from a paper by the late Emil Gerber ("Some Commercial Features of Structural Engineering," in *Proceedings of the Engineers' Society of Western Pennsylvania*, Vol. 23, 1907, p. 125) is here in place:

> A careful study of precedents is essential in these days. "There is nothing new under the sun" is becoming more nearly true every day. I do not wish to detract from originality but indifferent originality is more expensive and less creditable than good imitation, and the success of the engineer is directly proportional to the success of his work and to the lowness of its cost. Neither should precedents be followed blindly but the simplest and most direct means to the ends sought should be used.

Precedents have often been followed blindly, especially in specification writing. The Schneider Specifications for Steel Railroad Bridges contains a sentence, "Pins exceeding 7 in. diameter shall be forged under a steel hammer striking a blow of at least 5 tons." Mr. Schneider meant a *steam* hammer, but probably the proof reader failed to see the error, and "steel" it has remained in reprints and a number of specifications.

Rivets in Girder Cover Plates.—Another instance where precedent has been blindly followed is in a provision found in some specifications that cover plates of built single-web girders if 14 in. wide or over must have four rows of rivets. The writer is informed that the origin of this provision dates back to the 80's. Wilson Bros., of Philadelphia, were preparing designs and specifications for the Pennsylvania R.R. Cover plates 14 in. wide were piled on flange angles having an outstanding leg of but 4 in. The engineers wished the cover plates, where more than one, tacked together by a row of rivets outside the flange angles, and so called for four rows of rivets in the 14 in. plates. Because this clause was in the Pennsylvania R.R. Specifications it has been copied when entirely different conditions prevail. What reason is there for 4 rows of rivets to fasten 14- or 16-in. cover plates to 6 x 6-in. flange angles? In compression members it often borders on absurdity. Only two rows of rivets are used for the box-shaped top chords of bridges.

Maximum Rivet Pitch.—A clause found almost invariably in specifications for steelwork is that the maximum pitch of rivets in built-up compression members shall not exceed 6 in. During the early days of iron fabrication such a provision may have been needed but that is notthe case now. The rivets in flanges of plate girders take the increment of flange stress. This increment is often quite small. In columns the rivets hold the component parts together and take the stress due to flexure. It is recommended to designers of steel structures that the precedent established by two or three generations of specification writers be cast aside and that the maximum spacing for rivets be increased.

On the other hand, some attempts at originality are reprehensible. Occasionally an engineer will try his hand at beam connections. As is well known, the end connections are standardized for each size of beam, independent of its length. By proportioning the connections according to the loads carried a few pounds may be saved in weight, but changes in such standards as beam connections increase cost and, what is often more important, cause delay in fabrication.

Freaks of originality are often found in the return of working drawings sent for approval. If details are in error they certainly shou'd be corrected, but whims are expensive. To save $5 to the purchaser, the approver of details has been known to put the manufacturer to $50 expense by insisting upon details out of the usual.

To secure beneficial results the choice of originality or precedent should be studied for each individual case.

The Design of Lattice Bars

The great mass of articles and papers relating to lattice bars of compression members has been written since that memorable Aug. 29, 1907, the date of the Quebec Bridge disaster. The late C. C. Schneider ("Report to the Royal Commission on the Design of the Quebec Bridge") recommends that lattice bars be designed to resist a shearing stress corresponding to the allowance for flexure in the formula used for designing the column. This method is embodied in the "General Specifications for Steel Railroad Bridges," 1910, of the American Railway Engineering Association, and is followed by many companies. For the formula $16{,}000 - 70\ l/r$, used more than any other in specifications, the shearing stress S transmitted by the lattice bars is determined by the equation

$$S = \frac{560\ A\ r}{d}$$

in which A = area of section, r = radius of gyration of section about axis at right angles to plane of latticing, and d = extreme width of member in plane of latticing.

The handbooks of the Cambria and Carnegie steel companies, Modjeski in the design of the present Quebec Bridge, and a number of specifications call for the latticing of compression members to be strong enough to transmit in transverse shear 2% of the direct stress of the members. The specifications of the American Railway Engineering Association published in the January, 1920, *Bulletin*, call for 2½%.

Table V gives the maximum transverse shear in a number of columns made of two channels latticed, both by the equation $S = \frac{560\ A\ r}{d}$ and by assuming 2% of the safe axial load determined by the formula, $16{,}000 - 70\ l/r$ with a maximum of 13,000. The channels are spaced with flanges turned out and with the distance between backs such that the radii of gyration about the two rectangular axes are equal.

It is seen that for the colums in the table, representing ordinary construction of lengths between 30 and 100, 2% of the axial load is in excess of the shear derived by the method of th elastic curve. It is also seen that for columns with light loads or small areas the latticing will be ridiculously small if proportioned by either method. Most specifications require the width of the lattice bars to be not less than about 3 times the diameter of the end rivet and the thickness not less than 1-40 to 1-60 the distance between end rivets but in no case less than ¼ in. In ordinary structures these requirements will determine the size of latticing for compression members. When they do not, the writer recom-

mends that lattice systems be designed for a shear equal to 2% of the axial load.

Lattice bars are in compression as well as in tension. For compression they should be designed by the same formula used for designing the column. When bars are long it is often advisable to use angles instead of flats.

Struts Carrying Nominal Stress

A problem often arising in the design of steel structures, especially light mill buildings, is that of compression members with small or nominal stresses. The experienced designer, if left to himself, can solve the problem by drawing upon his experience and common sense. But the difficulty is that he is not always left to himself. Building codes and specifications usually put

TABLE V. SHEARS IN LATTICE BARS

Column	A Sq. In.	r Inches	d Inches	Load, Thousands of Pounds	$S = \frac{560\,Ar}{d}$ Pound	$S = 2\%$ of Load, Pounds
2 8-in. Chan. 11.25 lb.	6.70	3.11	9.5			
10 ft. long				87.1	1,228	1,742
20 ft. long				71.0	1,228	1,420
2 10-in. Chan. 15 lb. ..	8.92	3.87	11.6			
15 ft. long				113.7	1,666	2,274
20 ft. long				104.0	1,666	2,080
30 ft. long				84.6	1,666	1,692
2 12-in. Chan. 20.5 lb.	12.06	4.61	13.6			
20 ft. long				149.0	2,289	2,980
30 ft. long				127.0	2,289	2,540
15-in. Chan. 33 lb. ..	19.8	5.62	16.3			
2 35 ft. long				116.1	2,289	2,322
20 ft. long				257.4	3,823	5,148
30 ft. long				228.0	3,823	4,560
40 ft. long				198.4	3,823	3,968
2 15-in. Chan. 50 lb. ..	29.42	5.23	16.2			
20 ft. long				376.2	5,318	7,524
30 ft. long				329.0	5,318	6,580
40 ft. long				281.7	5,318	5,634

limits to the unsupported lengths of columns. No designer should object to this provided he is assured that they will be interpreted according to their intent and spirit rather than the strict letter. Two or three instances of what is meant will be given.

The building code of a certain city contains the paragraph: "Columns and compression members shall not be used having an unsupported length of greater ratios than given in the tables." The highest ratio of l/r given in the tables is 120. The design of a proposed building was passed upon favorably by the building department. During the progress of the work it was desired to use web plates instead of lattice bars for some columns. This increased the ratio l/r from 110 to 130, but although the sectional area was greater, the building department rejected the change, holding that it conflicted with the provision that no l/r should exceed 120. It was only after some argument that the change was allowed.

In another city a mill building was erected the past year with trusses 16 ft. apart and spanning 75 ft. between columns. The columns were but 15 ft. high. Because of a 120 limit for l/r in its building code the building department insisted that the longitudinal struts in the bottom-cord bracing, made of two angles back to back, should be increased from the size shown on the design to 6 x 4 x $\frac{3}{8}$-in. So there was the anomaly of struts between bottom chords, transmitting no calculated stress, made of greater sectional area than the chords themselves, which had to carry maximum stresses up to 86,000 lb. Another building in the same city, with trusses 14 ft. 10 in. apart, has the longitudinal struts in the plane of the bottom chord made of two angles 3-$\frac{1}{2}$ x 2-$\frac{1}{2}$ x $\frac{1}{4}$ in. in the older part and two angles 5 x 3-$\frac{1}{2}$ x $\frac{5}{16}$ in. in the newer part. In extending the building the working drawings of the previous portion were used except for these struts, as the building department insisted that they should be increased to meet the 120 limit on l/r in the code.

The former Memphis Bridge Co., in "Standard Specifications for Steel Highway Bridges and Concrete Foundations," had a clause which read:

> No compression member, however, shall have a length exceeding 140 times its least radius of gyration, except those for lateral and wind bracing, which shall not exceed 160. In figuring the radius of gyration, webs of columns and beams and inner legs of angles forming struts may be omitted, provided that the remaining flanges have the required area.

In response to a letter of inquiry, the one-time president writes: "I think the clause referred to covers a point that should be taken care of in all specifications. Certainly it is good sound common sense. A given amount of metal in a certain position has at least as much strength when tied together with continuous metal or solid plates as it would have if tied together by lacing bars."

The writer has in his own specifications a clause which reads:

> The effective length of main compression members shall not exceed 120 times their least radius of gyration, and for secondary members and lateral bracing 140 times their least radius of gyration. Any portion of the cross-section of a compression member may be neglected in computing the radius of gyration, provided that portion be neglected in the design of the member.

It is to be noted that the last sentence has its limitations and should not be followed indiscriminately. Eccentric loading, shock, rust, bending of horizontal and inclined members from their own weight, should be taken into account. In most cases, the rule can be followed with satisfactory results.

Points in Detailing That Affect Design

No engineer is thoroughly competent to design steel structures unless he has had previous experience in detailing. For this reason fabricating companies seldom employ as designers men who have not spent three or more years in making working drawings. Instructions for a drafting room can usually be read with profit by a designer. This may be the case with the following extracts from instructions prepared by F. L. Castleman, Plant Engineer of the American Bridge Co., at Pencoyd, Pa.

Where one-hole shop connections are required, use bolts instead of rivets where allowable, as it is very difficult to drive shop rivets in one-hole connections. Avoid the use of clip angles requiring two shop rivets. Use three rivets where practicable. This does not apply to top or bottom connections for beams to columns, as these clips can be easily held in place while riveting.

No ditto signs are to be used on general plans. All sizes and elevations must be repeated.

Open holes in beams and in beam connections should be figured from the bottom of the beam so that the work can be laid out from the bottom of the beam, and any variation in depth of beam be thrown from the top, where the detail is usually such that the variation in depth will cause no interference. In cases where the beam should be laid out from the top in order that the distance from top to the first hole be exact, the distance should be marked "exact." Beams that are required to be flush on top should be figured from the top only.

In using standard connections for beams, especially short

beams, be sure that they are capable of carrying the loads that the beams take.

Pairs of beams with less than 2½ in. (preferably 3 in.) between flanges can have neither rivets nor bolts inserted. For such cases use through bolts or single 6 x 6 angle riveted to girder beams.

Pairs of girders with less than 3 in. (preferably 3½ in.) between flanges should be provided with hand-holes not less than 6 in. in diameter. Space hand-holes so that a man does not have to reach more than 2 ft. up or down to insert a rivet. Hand-holes are not needed when the distance between flanges is over 3 in. (preferably over 3½ in.) and a man does not have to reach over 2 ft. up or down to insert a rivet.

See that depth of piece does not exceed shipping clearance.

The method of fireproofiing should be well understood, so that seat angles can be cut where necessary to keep them within the fireproofing.

Avoid as far as possible bevel cuts on plates and angles for both main and detail material. Avoid the use of curved angles where one or both ends are too long to allow the angle to be punched.

The matter of foreign freights should be carefully watched. Detail export work, as far as practicable, knocked down, and so that ocean freight is paid by weight and not by measurement. Where a gross ton of 2,240 lb. occupies more than 40 cu.ft. of space the ocean freight has to be paid by measurement. Additional rates are often required for pieces over 30 ft. in length and pieces weighing over 4,000 lb. Projecting pieces should be shipped loose, to avoid bending and breaking in loading. Special consideration should be given each order for this feature.

Neglect of "Trivial" Matters

Some of these points may seem trivial to the designer, but it is the lack of knowledge of trivial matters that often adds to the cost of fabrication and erection. For instance, an architect designed a number of girders, carrying heavy loads, of pairs of 20 and 24-in. beams spaced 8 in. centers. This gave a distance of less than 2 in. between flanges, causing difficulty in detailing, fabricating and erecting. There was but little reason why the distance of 8 in. could not have been 10 in., avoiding trouble and giving better conections.

In another instance connections of girders to columns in an office building were specified which, after the steelwork was erected, had to be cut with an oxy-acetylene flame to bring them within the fireproofing.

Still another instance is a case where the dimensions locating seat angles for beams connecting into girders were given from the bottom of the girders. During fabrication the top flanges became slightly displaced, but the workmen gave little thought to it as they maintained the distance from the bottom flanges to seat angles. When it came to erection the beams had to be coped in the field, at large expense.

Fuel Saving by Electrifying Railroads

A fuel saving of 122,500,000 tons of coal per year would be effected by the electrification of all of the railroads in the United States according to a statement of Frank M. Kerr, Montana Power Co., Butte, Mont., in making the report of the Committee on the Electrification of Steam Railroads before the recent annual convention of the National Electric Light Association in Pasadena, Cal. "If all the steam railroads in the country were electrified with power furnished from large steam generating electric stations, the total fuel required would be equivalent to 53,500,000 tons of coal, as against the actual figure for railroad coal used during the year 1918, of 175,000,000 tons."

Twin Concreting Plants for Large Foundation Area

Towers Instead of Cables Carry Main Chutes and Have Steep Zigzag Auxiliary Chutes—Large Storage Capacity

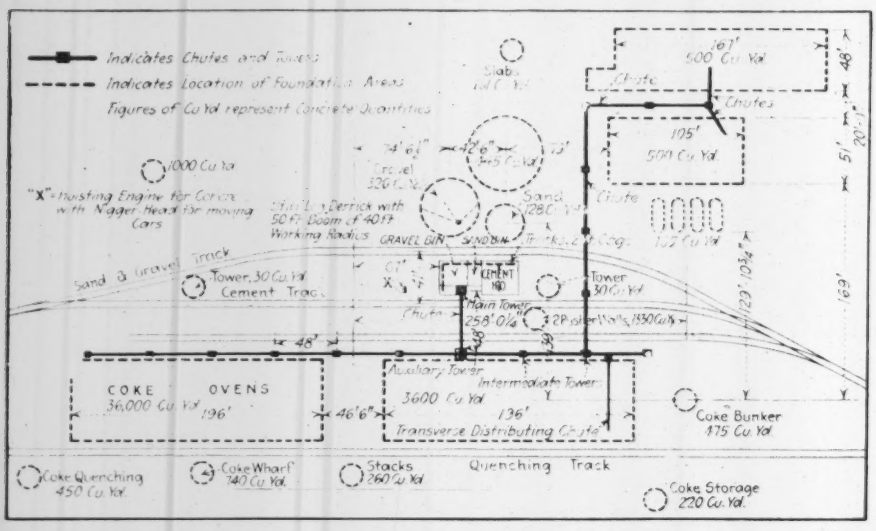
Two large concrete-mixing plants with distributing chutes supported by towers at 50-ft. intervals, and each plant serving a radius of 350 ft. from its main hoisting tower, form the main part of the equipment for building the concrete-slab foundations and substructures of the blast furnace and by-product coke ovens now under construction at Granite City, Ill., for the St. Louis Coke & Chemical Co. These two concreting plants are shown in Fig. 1, while Fig. 2 shows the layout of one plant.

The various foundations, some of which are of great size and which will require in all about 30,000 cu.yd. of concrete, are scattered over an area about 800 x 1,800 ft. The two concreting plants are about 1,200 ft. apart, each being located near the center of the yardage to be placed and convenient to the railway tracks which are laid over the site. The easterly plant serves the group of coke ovens and their accompanying structures, while the other serves the work for the blast furnace, power house and stock bins. Portable mixers operated by gasoline engines will be used for any small structures outside the radius of the main plants.

In the concrete distribution system the lines of chutes are supported by timber towers spaced about 50 ft. c. to c. instead of being suspended from cables stretched between towers at considerably larger intervals. One reason for this was that the plants will be in use for a year or more, and it was considered that there would be less trouble with a rigidly supported chute system.

It is the contractor's opinion that in first cost of installation there is little difference, the cable system being slightly the cheaper. The greater rigidity and permanence of the tower system, however, make this cheaper in operation where a large yardage is to be placed. There is thought to be less danger of clogging the rigid chutes, as those which are suspended deflect due to the sagging of the cable under load, which thus reduces the slope ahead of a heavy batch of concrete. When clogging does occur, as it may in either system, the rigid chutes are the more quickly cleaned and restored to operation, because the men can work to better advantage and have less fear in working on them. Further, it is considered that in the event of a chute breaking the damage is likely to be confined to narrower limits and to be repaired more readily with rigidly supported chutes. In fact, a case is cited at Fort Worth, Texas, where considerable damage was done and the work was delayed seriously owing to the breaking of the cable of a suspended chute system.

The hoisting tower at each plant is 175 ft. high, with a 1-yd. elevator bucket discharging into a hopper near the top. At the west plant there is a second hopper, about 50 ft. from the ground, to serve the large foundation for the blast furnace. About 30 and 40 trips per hour could be made to the upper and lower hoppers respectively. From the outlet gate of the upper hopper in each case a short chute leads to the main line of chutes. Branches from the latter are built as required, the flow to them being regulated by gates.



LAYOUT OF CONCRETING PLANT SERVING A RADIUS OF 350 FT.

The greatest length of the main chute is about 350 ft., while the maximum distance from the hoisting tower to the point of discharge is nearly 450 ft. Portable extensions mounted on cars may be placed at the lower ends of the fixed chutes. Wood is used for the chutes, which are 12 in. wide and 8 in. deep, the spans between the towers being stiffened laterally by truss wires over horizontal struts. These struts carry gang planks, so that there is ready access for repair and cleaning.

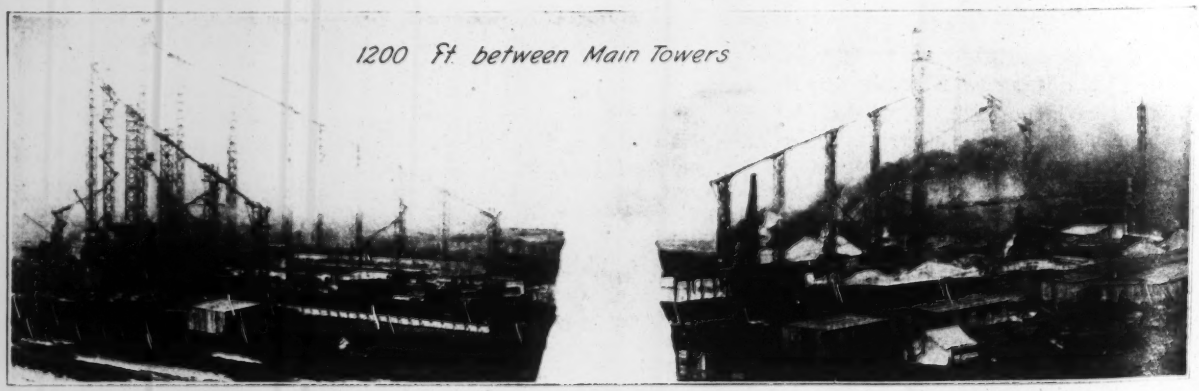
A uniform slope of 1 on 3 is employed, this being sufficient to give a free flow for a fairly stiff concrete without fear of clogging. To deliver concrete at points beneath the main chutes, there are zigzag drops composed of short lengths of chute built into the towers, portable chutes being connected to these at any required height. In these zigzags the slope is 45 deg., but as spilling sometimes occurs it is planned to cover many of these short steep chutes.

Concrete materials are brought in by rail, large stockpiles of stone and sand being formed and large sheds stored with cement in sacks so as to provide against delay in case of traffic interruption. At each plant the stockpiles will average 1,000 tons of stone and 1,000 tons of sand, while the cement shed provides storage for six carloads. A stiff-leg derrick with ¾-yd. grab bucket and 50-ft. boom is erected on a platform to unload the cars of aggregate and also to supply the bins over the mixer, which hold four carloads of stone and two of sand. Cement sacks are unloaded from cars by hand, being placed on a small flat car which runs on a lateral elevated track into the cement shed.

Measuring hoppers in the overhead bins are directly over a two-compartment charging hopper. When these compartments have been filled with stone and sand the cement is added and the hopper then tilted to deliver the batch to the mixer. An operator at the charging hopper controls the feed gates and the hopper by means of a bank of levers. Two or three men are required to deliver the sacks of cement to the hopper. The 1-yd. mixer is driven by an electric motor, its movements being controlled by an operator who also regulates the water supply. An automatic device insures that the batch is retained in the mixer for the specified period of about 1 min. The mix is 1:3:5, or in some cases 1:2:4, using stone of 1-in. to 2-in. size.

About 350 men will be required when the work is in full swing. As most of these come from St. Louis, ten miles distant, a spur track has been laid from an electric railway, and special cars leave at stated hours, this service being paid for by the coke company. At night each man is given two tickets, one to take him home and the other for returning to work next morning. A number of the men, however, live on the work and for these a commissary and bunkhouse are provided, having 50 bunks and accommodation for 150 men at meals.

This foundation work, which will aggregate about 30,000 cu.yd., exclusive of concrete piles, is to be completed by the end of 1920. The Fruin-Colnon Contracting Co., St. Louis, has the contract, with S. W. Bowen as engineer in charge and Charles Schrader as superintendent of construction. The work is under the general direction of P. E. Irvine, general super-



TWO CONCRETING PLANTS 1,200-FT. APART SERVE LARGE AREA OF FOUNDATIONS AND HAVE CHUTES SUPPORTED ON TOWERS

intendent for the St. Louis Coke & Chemical Co., of which C. S. Lom .x is chief engineer.

Mutual-Admiration Societies

By P. B. McDonald
Assistant Professor of English, College of Engineering, New York University

OF LATE years it has become fashionable to organize societies. The argument for them is that they cannot do any harm and might do some good. A nucleus of members is obtained by inviting a few people who have an axe to grind; others join because these joined. If all goes well, the society is soon holding regular meetings, choosing officers and committees, and publishing a periodical. Thus we have societies for promoting or preventing nearly everything that can be promoted or prevented—from using dental floss to docking horses' tails. As someone recently said, "In this country one is asked, 'Are you succeeding at what you are doing'? in contrast with the French query 'Is what you are doing worth while'?"

Perhaps it is true that this plethora of societies does occasional good and little positive harm. But they consume a great amount of time, and clutter up the mails, and emphasize the American tendency for mutual admiration. At a typical meeting of a typical society Jones gets up and tells how he uses his dental floss or how he persuaded his neighbor not to dock his horse's tail. When he finishes his valuable and spirited talk (later to be published in the society's bulletin) Brown rises and compliments Jones on his masterly address before beginning his own story of the "Brown method" of manipulating floss. Robinson then compliments both Jones and Brown, and adds his priceless opinion. Finally, the chairman compliments everybody and the meeting is adjourned. The only variation to this pleasant procedure comes when a member strays in who believes in criticism rather than in mutual admiration. But he is promptly suppressed as being "impossible" or "merely a destructive critic," and the pink tea continues.

While speaking of destructive criticism, which so many good people condemn, it might be noted that most of the great critics of history have been destructive, such as Horace, Boileau, Pope. Swift. Voltaire, Hume, Carlyle. They attached the silly fads of their day in order that people might perceive more clearly the really great and eternal things, as Professor Babbitt of Harvard has pointed out. It is the opinion of such keen observers as Paul Elmore that the world today needs a Pope or a Swift to satirize the foolish. Caustic criticism of, say the church, does not necessarily mean that the church is entirely wrong, but that its procedure at the time is wrong. Hume did not attack the beliefs of the church, but the false proofs that the church advanced in the 18th century. A destructive critic such as Hume clears the way for a better building-up of belief. He should not be condemned for not doing the building himself. Furthermore, destructive criticism is suggestive—Hume woke Kant from his domestic slumbers—and in a way it is complimentary, since it implies that the subject attacked is important enough to warrant criticism. To call a man "behind the times" may mean that, in a better humor, the critic would praise him for staunch loyalty to proved ideals.

But, to return to the muttons, mutual-admiration societies are making Americans narrow-minded. The atmosphere of such gatherings is vitiating. A chemist who has come from a meeting of a chemists' society where only pleaasnt remarks are encouraged feels that chemistry is the be-all and end-all of creation. He is likely to become so chemically-minded that he almost ceases to be a human being. The society may discourage adverse criticism so thoroughly that it, itself, becomes tedious and humdrum.

Possibly the mutual-admiration spirit is the consequence of what might be called the "Pollyanna" or "glad" idea. It partakes a litt'e also of the "brotherly," "man-building" enthusiasm of up-lift movement, and a little of the "advertise-yourself" principle of chambers of commerce. From all sides people are being urged to get together and form mutual-admiration societies. Employers are advised to give a half-hour talk each noon to their workmen so that the men can see what a nice employer they have. Freshmen arriving at college are herded together to be lectured to by some sanctimonious fellow concerning the evils lying in wait for young boys fresh from home. As much as possible is being done by large meetings and associations; as little as possible is left to the individual. Is it any wonder that the number of flabby uninteresting people seems increasing?

Some years ago, when organizations were relatively few, a vigorous organization of selected persons could frequently advance their own interests considerably. But today, when every class or group is organizing, it is a public detriment to have so much partisan spirit displayed. Democracy, as Herbert Hoover has pointed out, does not mean a war of classes; rather it means a form of government under which the individual counts for something. A candidate for an elective office today cannot be a plain citizen; he must belong to all the fraternal and sectarian organizations possible.

America has overdone the idea of organization. Too many organizations have become merely mutual-admiration societies, breeding narrowness and factionalism. Individual criticism has not been properly encouraged. It is the salvation of a democratic form of government. The overdose of system which the world received from Germany should be recognized as unpractical, and the right kind of individualism should be revived—not the individualism of eccentricity and anarchy, but the individualism which produces well-balanced individuals able to think and judge for themselves.

Steam Shovel Reduces Quarry Loading Cost

The greatest increase in output, the greatest saving in labor and greatest decrease in the cost of production in crushed stone quarrying, states O. P. Chamberlain, general manager, Dolese & Shepard Co., Chicago, in a paper read Feb. 12, 1920, before the American Road Builders Association, can be secured by substituting loading by steam shovel for loading by hand. The following data are given: A steam shovel operating at cost of $55 per day of 10 hr. and producing 1,000 tons per day, loads at a quarry cost of 7.8c. per ton, against 20c. per ton for hand loading. These figures include a depreciation and maintenance charge on the shovel of $7,000 per year, and are conservative, as, in the writer's own operation, the steam shovel performances, averaged over long periods, are 1,780 tons per day of 10 hrs. Such operation means a loading cost of but 4.4c. per ton of stone loaded. Using the conservative figures of a saving of 7.8c. per ton in a one-shovel plant, which should produce 400,000 tons per year, the annual saving in the substitution of steam-shovel loading for hand loading is $58,800.

Protecting Buildings Against the White Ant

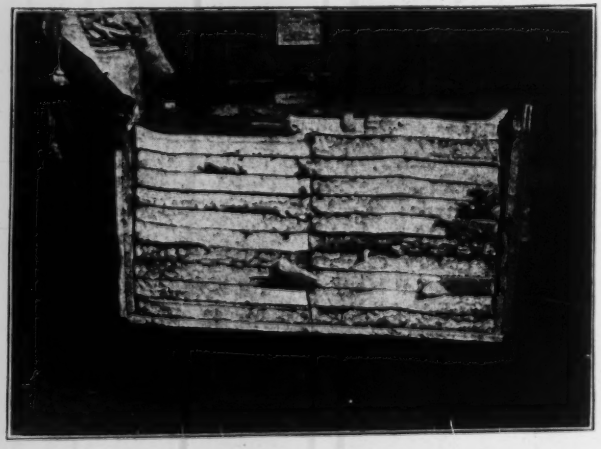
Precautions in Construction to Keep Out Insect Which Destroys Much Property All Over United States

By Thomas E. Snyder
Specialist in Forest Entomology, Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C.

IT IS not generally realized that it is necessary to protect buildings in the United States against the ravages of "white ants" or termites. These insects and their damage are usually supposed to occur only in tropical countries. This is a wrong conception, since the Bureau of Entomology, U. S. Department of Agriculture, receives on the average 40 to 50 requests per year for information as to how to get rid of "flying ants" or white ants which damage the foundation timbers and other woodwork of buildings in all parts of the United States. About one dozen of these requests are annually received from Washington, D. C.

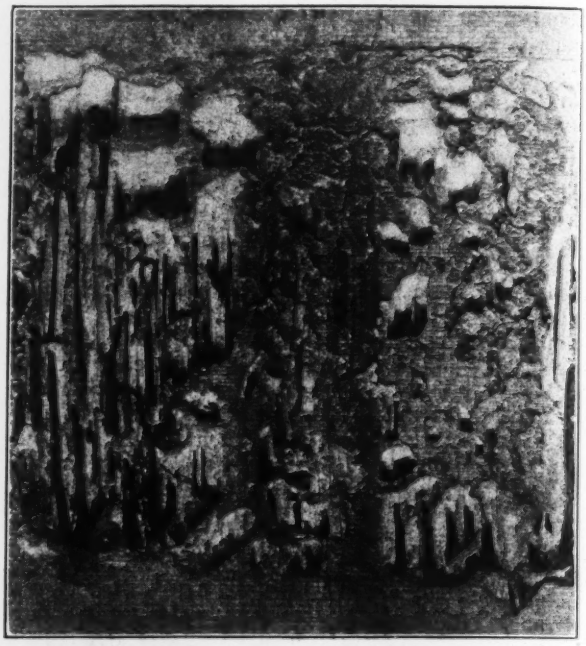
Damage to both old and new buildings occurs not only in rural communities but also in large cities and affects the welfare of manufacturers, farmers and householders. While the damage is more common in the southern and southwestern states, it occurs in all sections of the country, even in the far northeast and northwest. Even when the damage is discovered, the usual belief is that the insects which are doing the damage, i. e., the white ants, are from Africa, China, or some other foreign country. This is not true. There are 39 species of termites or white ants in the United States—a greater number than the combined known species of such tropical countries as Japan, Hawaii, and Cuba; or than in both Japan and Panama together.

Some notable cases of such damage which have been successfully treated by this Branch in the past few years are: In Washington, D. C., the flooring of the basement of the old building of the Bureau of Engraving and Printing where valuable documents were destroyed, the remedy alone costing $1,000; the flooring in the basement of the vault room of the new building of the Bureau of Engraving and Printing, where valuable silk-fibre bond paper has been destroyed; documents stored in the basement of the Treasury Building and plans stored at the Washington Navy Yard; flooring and exhibits in the old National Museum (above); a Christian Science church in the northwest section; the parquet oak floor of a tailor shop in the northwest business section, the remedy costing over $1,000; and the foundations and the woodwork in a number of valuable residences.



BOX OF SILK FIBER BOND PAPER RUINED BY WHITE ANTS

Insects bored up through an improperly constructed concrete floor in the basement of the U. S. Bureau of Engraving and Printing, Washington, D. C.



AUSTRALIAN HORSECHESTNUT BOARD DAMAGED BY WHITE ANTS WHICH CAME THROUGH FLOORING

Old building U. S. National Museum, Washington, D. C.

The flooring and woodwork of a valuable residence at New Orleans, La., remedy costing $3,000; the flooring of a large hospital at Dover, N. H.; a railroad station at Baltimore, Md.; a factory building at Bloomfield, N. J., and the foundation timbers and woodwork of valuable residences in St. Louis, Baltimore and New York are examples of similar damage which has occurred recently at other localities.

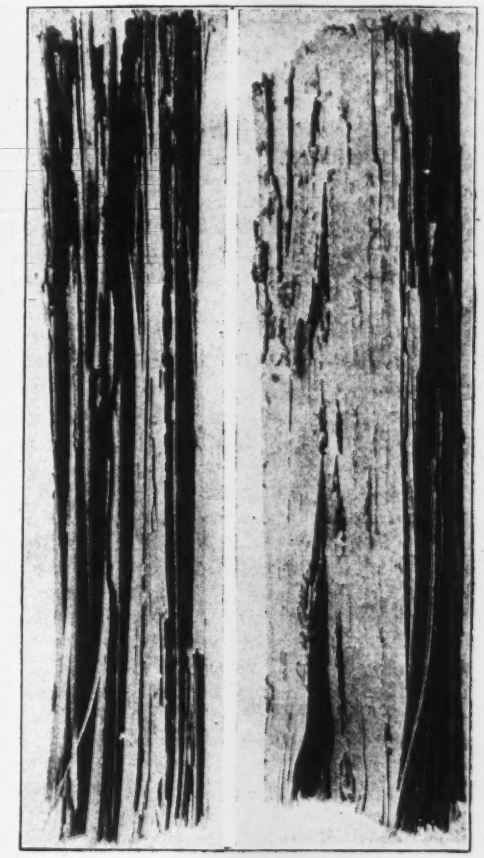
In all the cases of serious damage referred to this Bureau recommendations have been made and, when these were adopted and properly carried out, no further damage occurred, but cases where it was attempted to merely patch up the damage and kill the few insects which were exposed in the infested timber resulted in failure.

No insects occurring in houses are capable of greater damage than termites or "white ants," not only to the integrity of foundations but also to the contents of the buildings. The damage they do is usually hidden until beyond repair; they work in the interior of the wood and do not come to the surface except when the winged adults swarm in the spring.

A prevalent idea, even among entomologists, is that termites only infest *old* buildings. It is not the age of a building but the manner in which it is constructed that renders it liable to attack. Improperly constructed *new* buildings, which have been built for only one, two, or three years, are commonly badly infested. The insects during this period have often reached the second and third floors. Indeed, we have records of serious

damage to the foundations of improperly constructed buildings which had only been completed for from three to six months.

Such damage is all in unnecessary expense. It has been found by investigations conducted by the Branch of Forest Entomology that white-ant-proof buildings can be constructed just as effectively as rat-proof buildings. The old recommendations for remedying and preventing damage by spraying, fumigating and patching up are utterly useless and result in a sense of false security which is soon dispelled by the reappearance of the insect in more numerous hordes.



PINE FLOORING OF RESIDENCE DAMAGED BY WHITE ANTS IN NEW ORLEANS, LA.

Note the paper-like consistency of the wood which has been eaten out in layers, with the grain, the insects preferring the softer rapidly growing wood.

Both the remedy and preventive is the same in case of measures against our common species of white ants (species in the genus *Reticulitermes* Holmgren), namely, complete isolation of all untreated wood from the ground.

Since these insects always require access to earth, when this source of moisture is shut off they will not be able to extend their galleries farther and will perish. In case of infested frame buildings, when once the infested beams are disconnected from the earth, the insects infesting the woodwork, no matter in how great numbers, will soon dry up and die. Thus, if the untreated foundation timbers are cut off from contact with the soil, the source of moisture, the white ants will die in the flooring and woodwork, even if they had penetrated to the second and third floors.

This positive and demonstrated fact has resulted in a great saving in reconstruction since, unless seriously structurally weakened or the wood is continually damp, the damaged woodwork need not be removed because the white ants will dry up.

One of the most common sources of infestation by white ants in the case of buildings constructed of stone and steel is through improperly constructed concrete flooring. Usually, the base of the concrete floor is a loose combination of coarse gravel or cinders and cement grout. This very rough conglomerate, although several inches in thickness, has many cracks and even large holes through it. Over this is laid a solid concrete, about two to three inches in thickness, of fine texture. However, in this concrete, while it is still moist, wooden sleepers are laid; these untreated sleepers extend down to or nearly reach the coarse, open conglomerate—which is in contact with the earth. To them is nailed the wooden flooring.

It will be seen that this is faulty construction. White ants have free access from the earth, in which they have galleries, through the porous conglomerate to the untreated beams and flooring (see diagram A). There should be a layer of solid concrete of a thickness of at least 1 in. between the grout and the wood (see Diagram B).

Other sources of infestation in the case of stone or steel buildings are steel or stone pillars or piping extending down through the concrete floor to foundations in the earth. Often there is not a tight connection between these pillars or piping and the concrete floor. Overlapping strips of metal extending horizontally several inches from the pillars or pipes should be embedded in the concrete floor in order to obtain a tight point of juncture (see Diagram B); or liquid (adhesive) asphalt pored in to plug up the crevice.

White ants will utilize any such crevice to leave the ground and penetrate through the flooring in search of wood—their food.

The following suggestions are important:

EARTHLIKE SHELTER TUBES OF WHITE ANTS

Constructed of earth mixed with finely digested, excreted wood and built over brick wall in heated, dark, damp basement. These tubes extend through cracks between the basement pipe flooring and the wall near a steam radiator. Note the granular structure. The insects use these tubes in passing over impenetrable substances and to protect them from the light in extending their galleries—in this case up to the next floor in an old building in Washington, D. C.

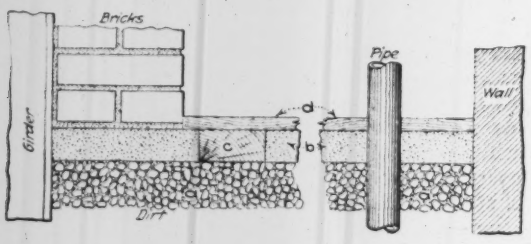


DIAGRAM A

a = Gravel or cinders loosely cemented with coarse concrete, 3 in. thick, but with many crevices and holes.
b = Solid dense concrete, 2 in. thick.
c = 2 x 4 in. untreated wood sleeper set *in* moist concrete over the grout.
d = ⅞-in. pine flooring nailed to sleepers.

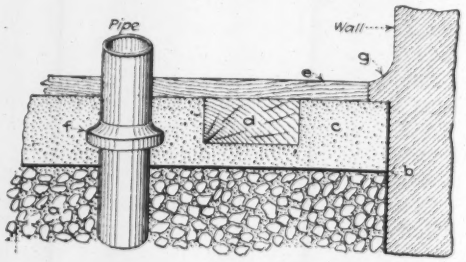


DIAGRAM B

a = Gravel or cinders loosely cemented with coarse concrete, but with many crevices and holes.
b = Asphalt waterproofing ¼ in. thick.
c = Dense concrete, 3 in. thick.
d = 2 x 4 in. untreated wood sleeper set in concrete.
e = ⅞-in. flooring nailed on sleepers.
f = Metal collar around pipe which runs down through the concrete; this collar should be soldered to the pipe and embedded in the concrete.
g = Shoulder of concrete at point of juncture of wall and concrete floor to avoid a right angle connection and consequent cracking.

IMPROPER AND PROPER METHODS OF BUILDING GROUND FLOOR TO PROTECT AGAINST WHITE ANTS

In order to prevent the insects from reaching the woodwork of buildings from these nests in the ground the foundations should, where possible, be entirely of stone, brick, or concrete, including the pillars in the basement or cellar. The walls, partitions and flooring in the ground floor, basement, or cellar should also be of concrete. Wooden flooring can be laid over this concrete floor if more desirable. Concrete floors should be of the densest concrete possible, so as to avoid dampness and should be strong enough to prevent cracking. The points of juncture between concrete walls and flooring should be filled in by rounding off the concrete at these places, since cracks often occur where the wall and floor join at right angles; termites often come up through cracks between walls and flooring.

Bungalows or frame buildings in the country which have no cellar should be raised from the ground on stone foundations to a height which will allow light and air to penetrate beneath.

Where stone or concrete foundations are impracticable, timber impregnated with coal-tar creosote should be used. Untreated beams should never be laid on the earth. Where beams are embedded in moist concrete, the concrete should be allowed to dry before the wooden floor is laid. If not, they will rot even if they do not become infested with white ants.

If possible, at least one sheet of asphalt waterproofing should between the grout and the solid concrete. Then sleepers are blocked up and laid on this asphalt before pouring in the concrete about them.

The supports of the woodwork of coal bins in basements or cellars should not be set in the ground but should rest on concrete. Window sills and frames in the basement or cellar should be laid over concrete, and the woodwork should not come in contact with the ground through which white ants can come up from subterranean galleries. Complete dryness of foundation timbers and basement walls and flooring is an important means of rendering buildings safe from attack by white ants. Good subventilation should be secured; that is, a deep air space should be left between the ground and wooden flooring.

Supports of porches or steps should never be laid directly on the ground but should rest on rock or concrete.

More detailed information on termites or white ants may be obtained from Farmers' Bulletin No. 1,037, U. S. Dept. of Agriculture. In this bulletin the procedure is outlined by which it is possible to get rid of white ants, which are already infesting buildings. Initial proper construction will, however, insure against such damage.

State Aid for Cheap French Dwellings

THE French law of April 12, 1906, amended Dec. 23, 1912, relative to state loans to enterprises engaged in the building of cheap dwellings has been further amended so as to provide for multiple dwellings, or apartment houses. The principal provisions of the amendment according to a recent issue of the *Monthly Labor Review* issued by the Bureau of Labor Statistics, U. S. Department of Labor, allow certain state aid on multiple dwellings when the annual rent of each apartment does not exceed at the time of construction a maximum of 300 francs per year for three rooms and toilet containing a total floor area of from 376.7 to 484.4 sq.ft., for communes having a population of 5,000 and under; to 720 francs per year for the city of Paris for the same number of rooms, with the same approximate floor area. For more than 484.4 sq.ft. of floor space the maximum annual rental is fixed at 325 francs for communes of 5,000 population and under to 760 francs to the city of Paris and the Province of the Seine. The law also applies to construction of apartments containing two rooms with kitchen and toilet, one room with kitchen, and one isolated sleeping room.

The annual rental of individual dwellings is fixed at 4 per cent of the actual cost. The state may advance through the mortgage bank not more than 200,000,000 francs and the Bank of Deposit and Consignation (under government supervision) is authorized to advance not more than 300,000,000 francs for such enterprises.

Loans are to draw 2 per cent interest annually if used in the acquisition or construction of individual cheap dwellings, or in the acquisition of small properties, under the provisions of the law of April 12, 1906, that of April 10, 1908, and subsequent laws. If used for the acquisition or construction of cheap dwellings or small properties for rent only, the rate of interest is 2½ per cent. Provision is made for loans for completing dwellings now under construction.

Repair Holes in a Concrete Ship With Cement Gun

Patches Readily and Successfully Placed Over Holes Punched in Hull of Government Concrete Freighter

ONE of the arguments which has been advanced in favor of concrete ship construction is the ease of repair. In proof of this a recent experience with the United States Shipping Board's concrete freighter "Cape Fear" is offered.

The "Cape Fear" was built by the Liberty Shipbuilding Co. at Wilmington, N. C. It is of the so-called 3,500-ton class, designed and built by the Concrete Ship Section of the Emergency Fleet Corporation. The ship while recently in New York harbor suffered some damage by collision either with a pier or with some other craft, and three holes were punched in her port side. One was just aft of the collision bulkhead, one in the fore hold, and one abreast the boiler room. In New York it was attempted to repair the ship by chipping out the largest hole, approximately 4 ft. square, clear through the shell and pouring concrete between inner and outer forms. It was found, however, that this method of repair would not insure a perfectly tight hull and when the ship came into Newport News it was decided to make a new repair in the yard of the Newport News Shipbuilding & Dry Dock Co., using concrete placed by the cement gun.

The work was done under the direction of Godfrey L. Smith, civil engineer of the company, and the information herewith is from a statement of the repair job made by Mr. Smith.

The first procedure was to cut out all of the concrete that was placed in New York and to clean out the shattered material in the smaller holes which had not been repaired in New York. A form was then put on the inside of the ship at each hole about 3 in. clear of the inside of the shell and the mortar placed against this form with the cement gun. The extra 3-in. thickness was not thought necessary in the yard but was placed because the captain of the ship very much desired an added thickness shell to insure a perfectly safe patch.

The reinforcement of the shell, as shown in the view herewith, consisted of two networks of small rods, one near the outside of the shell and one near the inside, and these rods were so closely spaced it was necessary for the workmen to stop guniting twice and to cut the concrete off the reinforcement with trowels in order to get the necessary amount inboard of the reinforcement. The holes were finally filled, however, up to about ½ in. outside the hull, after which they were trimmed down to a fair line by means of shape steel trowels and the surface rubbed by wooden floats.

HOLES IN HULL OF CONCRETE SHIP "CAPE FEAR"

Inasmuch as the captain was in a great hurry to get away from the yard, it was then decided to speed up the hardening process by steaming. A canvas screen was dropped over the side of the ship well over the patches and held close against the ship. Live steam was then turned into the space between the canvas and the hull and kept on all night. The following morning the steam was shut off, the canvas screen raised and the surface rubbed down smooth with a carborundum brick and water. The canvas screen was then replaced and steam was left on all of that day and night. The following morning it was evident that the job was entirely satisfactory as there were no cracks anywhere in or around the patch. It was then painted with a special concrete paint and when this was dry a coat of black asphaltum varnish was applied. A hose test of 1¾-in. nozzle and 150-lb. water pressure was applied 12 to 15 ft. from the patch and showed no leakage through the hull at any place. The ship left a day after the final patching and so far as is known suffered no further difficulty in its hull.

Reconstruction Work in France

The work of reconstruction is proceeding so slowly in the devastated regions of France that efforts are being made to reorganize the administrative service, which seems to be wholly incapable of carrying out this vast undertaking. Apart from the reconstruction of roads and bridges, very little has been done beyond clearing up some of the areas. Most of them have remained untouched. The inhabitants complain that they can obtain no assistance and no redress, and it is urged that something must be done at once to save the devastated regions from absolute ruin. The trouble arose first of all from the refusal to accept British and American aid immediately after the Armistice, when efforts were made to carry out the work of reconstruction under conditions that would have been highly advantageous to France, some groups of contractors even undertaking to accept payment out of the war indemnity. The French government, however, decided to reserve the work for French manufacturers. Besides, negotiations were in progress with the Germans to supply the necessary labor. The Germans have done practically nothing, and the French can do scarcely more on account of the financial situation not permitting of funds being devoted to the work. Now that it is proposed to compound with the Germans and secure from them a fixed sum for reconstruction, there is a prospect of a serious start being made with the work. In any case, if France is to benefit from a rapid reconstruction it can only be with foreign aid, so that there is a possibility of the government being induced to relax its present exclusive policy and permit British firms to assist in the carrying out of this vast work.—*The Engineer.*

New Pumping Plant for Water-Works of Peekskill, New York

Steam Turbine Drives Large and Small Centrifugals—Water Power Provided for Latter, or as Auxiliary in Turning Both

By Henry W. Taylor
Consulting Engineer, New York City

THE development of a new pumping installation for the water-works of Peekskill, N. Y., involved the consideration of the most efficient method of utilizing the water power owned by the city, the high cost of coal delivered to the pump house, and the necessity of installing the new apparatus while the existing pumps were kept in operation in the same pump room.

In the Spring of 1918, the pumping equipment consisted of (1) A Holly-Gaskell pumping engine with a nominal capacity of 3,000,000 gal. per 24 hours and a working capacity of not over 2,250,000 gal. per day. (2) Two displacement power pumps, which were operated from a jackshaft receiving power from a water turbine in the basement of the building, or from another jackshaft with pulley and belt to a Corliss engine. (3) A centrifugal pump, with belt drive from a 100-hp. electric motor. All this equipment was continuously subject to repair and was unreliable.

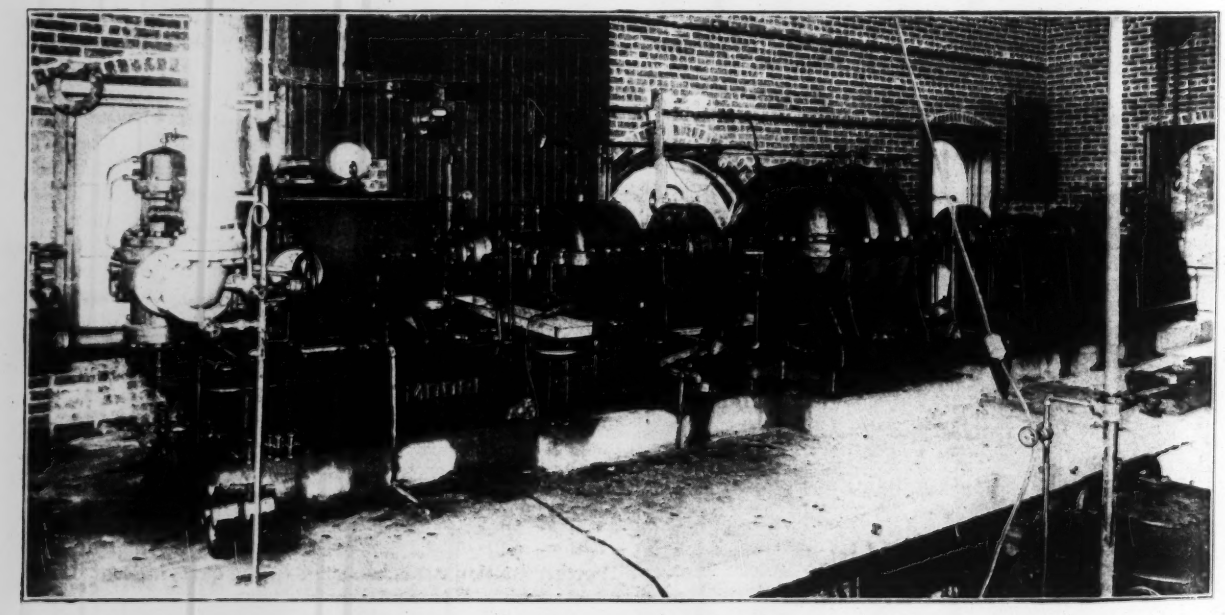
The required pumpage for 1918 was estimated at approximately 3,300,000 gal. a day. The existing main steam unit had a deficiency of about 800,000 gal. When the water-power pumps were driven by the Corliss engine (non-condensing) the coal cost rate was about twice that of the Holly-Gaskell pumping engine, and when electricity was used, the cost was prohibitive. The pumping head was about 360 ft.

From the reports of the Board of Water Commissioners the cost of pumpage per million gallons for the past three years was approximately as follows: 1915, $16.30; 1916, $17.80; 1917, $31.60. With coal prices of 1918, the cost per 1,000,000 gal. of operating the Holly-Gaskell old equipment was estimated as follows: Holly-Gaskell engine, $29.50; Corliss engine, about $45; Electric pump $70. As compared with the above, the unit cost of operation was estimated as follows: Pumpage by steam turbine, $28, assisted by estimated available waterpower, $17.45.

It was at first considered that a complete electric-driven pumping station might well be installed to avoid the excessive costs of coal, which, when delivered to the plant, about three miles from tide water, was costing over $8 per gross ton. Several schemes, however, were developed which included the use of electric-driven pumps, of modern steam pumps, of centrifugal pumps driven by steam turbine and water power and of units driven by crude oil, etc. When the matter was taken up with the Electric Light & Power Co., it was discovered that due to a large development charge involved in supplying the pumping station with about 400 hp. of electrical energy it would be impossible for the company to give a rate of less than 2.03 c. per kw.-hr., which was more than the cost of pumping by steam turbine gear set with direct connection to centrifugal pumps.

After a complete investigation the commissioners decided to install a 400-hp. steam turbine with gear reduction from 3,600 to 1,200 r.p.m. direct connected to a 4,000,000-gal. centrifugal pump which operates under a head of about 365 ft. To transmit the available water power to this same pump shaft, the 4,000,000-gal. pump shaft was direct connected to a belt shaft and beyond this belt section of shaft was installed a 1,000,000-gal. pump, operating against the same head. This small unit is available for use for water power only or for use in connection with the 4,000,000-gal. pump with both steam and water drive, to give a total capacity of 5,000,000 gal. from the new apparatus.

The water power is thus conducted to a large unit of high efficiency and is relayed by a steam drive at the other end of the pump. In past operation, the old reciprocating pumps with water drive required about 75 hp. to turn the apparatus over and consequently small amounts of water power were not subject to actual use.



NEW 5,000,000-GAL. PUMPING INSTALLATION AT PEEKSKILL, N. Y.

With the new layout, 25 hp. from the water power can be transmitted to the main pump shaft and reduce the steam consumption by this amount. On the other hand, when the new steam unit is shut down, and if there is a reasonable amount of water power available, one coupling can be broken and one made up, so that the water power is devoted entirely to the 1,000,000-gal. unit. From the point of view of water power, the new layout provides a steam auxiliary which makes up for a lack of water storage and at the same time provides a simple method whereby even minor quantities of water power can be transmitted to a shaft which operates a large unit of relatively high efficiency.

The turbine installed was a Moore, with a Moore gear set and a Schutte-Koerting water-jet condenser the steam inlet of which is on a line with the side outlet of the turbine. There are only two joints between the turbine and the condenser which can cause trouble from air leakage. The circulating water for the condenser is taken from the power head race and the water is pumped by a water-power-driven centrifugal pump which will produce a flow of about 1,000 gal. per minute. During the Summer time a vacuum of 28½-in. with a 30-in. barometer is obtained and for lower temperatures of water a vacuum of 29 to 29½-in. has been obtained. The discharge from the condenser is carried to an auxiliary suction well and in case of low flows in the creek this circulating water can be picked up by the 4,000,000-gal. water supply pumped and delivered to the reservoir.

The turbine and gear set are mounted on one bed plate which is flanged at the ends and bolted to the bed plate which carries the 4,000,000-gal. pumping unit. The 1,000,000-gal. pump bed plate was extended to receive the intermediate shaft section containing pulley and belt from the water-wheel jacket shaft. The combined bed plate when bolted together represent a continuous plate about 26 ft. long. The overall length of the entire apparatus is 29¾ feet.

An auxiliary outfit is provided for the circulating water to the condenser consisting of a second centrifugal pump, which is electrically driven. The motor shaft of this unit is extended to receive a pulley and the motor is so placed that a small belt can be installed from this pulley to the main shaft pulley and the condenser pump can be driven from this main shaft when the water power is not available for protracted periods.

The new outfit includes also a new feed-water heater, a new feed-water filter and a full complement of venturi meters to measure flows of water, General Electric steam-flow nozzle and gage, pressure and vacuum gages and accessories for all parts of the machinery.

It was necessary to install the new apparatus and have the main unit of 4,000,000 gal. capacity in operation before any of the old apparatus was removed. The capacity of the old plant involved so small a margin of reserve that this proceedure was imperative as a precaution againstlong delays in receipt of different items of the new machinery.

The new outfit is installed in the room housing the water-power-driven pumps and the centrifugal pump and it was impracticable to place it elesewhere in view of the transmission of power from the water wheel in the basement of this room. The new turbine and centrifugal pumps were therefore installed on a concrete platform about 5½ ft. above the existing floor level. This brought the platform above the water cylinders of the old pumps and above the centrifugal pump. By making temporary connections for the discharge of the old power pumps, the new pumping unit was completely erected before any of the old pumping units were put out of commission. This elevated platform also made it possible to install all the suction, discharge and by-pass piping for the pumps and auxiliaries underneath this platform and did away with the necessity of doing any work in the rough basement underneath the pump room where the handling of heavy pipe would have been extremely difficult. All connections are available for inspection and repair above the main floor of the room. This method of installation, which was required by the circumstances and the necessity for which developed as the work progressed, undoubtedly increased the cost of the installation.

The suctions of the centrifugal pumps were installed without valves and are primed by a connection to the vacuum chamber of the condenser. The pumps are Alberger multi-stage centrifugals.

The total cost of the installation was practically $24,000. The work was done under the trying war conditions of labor and equipment deliveries. No contracts were let except those for machinery, and the work was carried on by the Water Commissioners without a general contractor. The work was started in October, 1918, and the large unit was put into operation in April, 1919. Subsequent adjustments in alignment of turbine, gear and pumps indicated that the original allowance for expansion in the gear was much too large. Temperatures of the water pumped and used in the condenser and for oil cooling materially affect alignment and various alignments were made before satisfaction was obtained and vibration of couplings and excessive noise in gear were eliminated.

Recommendations Made for Engineer License Law in Minnesota

The engineer's license laws of Iowa, Oregon and Florida most nearly fulfill the requirements of a desirable and ideal license law, according to a recent report of the legislative committee of the Twin City Chapter of the American Association of Engineers. The report names the important features of a license law to be:

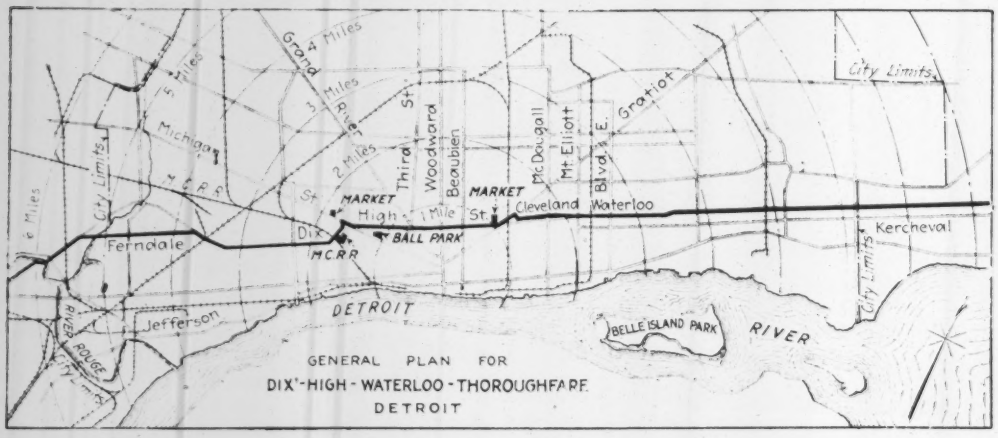
Definition of professional engineering, land surveying, and architecture, and of professional engineers, land surveyors, and architects.
Qualifications for registration and method of determining qualifications of applicants.
Reciprocity.
Application of law.
Revocation of license for cause.
Penalty for violation of act.

The committee recommends that in the license law proposed in Minnesota one of the members of the board of examiners shall be the dean of the engineering college in the University of Minnesota. A further recommendation is that members of the board should be appointed by the governor from nominees submitted by the constituent engineering societies of the Joint Engineering Board of Minnesota.

The committee also recommends that no exemptions to the law be made, except for Government and military engineers on Government or military work, or those constructing buildings for themselves and for their own use at a cost of five thousand dollars or less

Cross-City Thoroughfare to Relieve Detroit Traffic Problem

THE Common Council of the City of Detroit has approved the opening and widening of a portion of the Dix-High-Waterloo thoroughfare, which is a cross-city boulevard proposed by the City Plan Commission to relieve traffic congestion. The establishment of a wide and continuous crosstown street which will intercept the existing main radial streets before they reach the business center, will, it is pointed out by the City Plan Commission, secure effective relief from present conditions. The provision for rapid and direct east or westbound traffic across the city will also tend to collect and disperse most traffic directed to or from northern sections of Detroit without having it pass through the central zone of greatest congestion.



GENERAL PLAN OF PROPOSED THOROUGHFARE

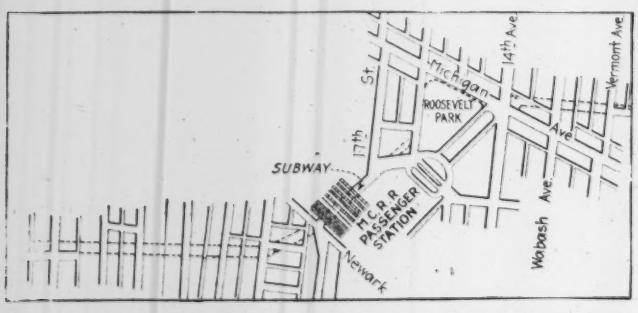
Careful study and consideration of the present traffic problems of Detroit, which bear directly upon the existing layout and widths of the main business streets, led finally to the selection of High St. for an intersecting downtown thoroughfare. It is already a fairly continuous route across the main part of the city, and it is planned to widen and extend it as indicated on the accompanying map to join Dix Ave. on the west and Waterloo St. on the east, thus forming a continuous crosstown business route between the east and west industrial belt, and adjacent commercial centers.

High St. parallels the river front about a mile north of it, and is just far enough away from the center of Detroit to separate through traffic from the slower moving traffic of the downtown district. Its total length within the city limits, together with the extension proposed, would be approximately 12 mi. It passes through the eastern market place and gives fairly direct access to a similar market center on the west side of the city. Furthermore, it goes directly in front of and almost along the west side of the Michigan Central station and thus makes that railroad center directly accessible from all parts of the city, though more especially so from the east and north.

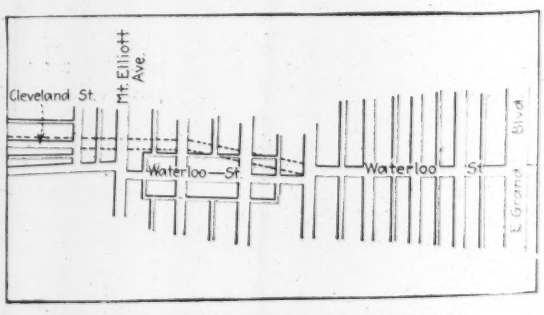
The present plan suggests the widening of High St. and its extension within the more congested sections of the city to a width of 80 ft. This width is based upon the latest standards of traffic experts according to the newest types of auto trucks and other commercial carriers, and has been supplemented by traffic counts at known points of street congestion along the proposed route. The City Plan Commission is awake to the fact that great expense is attached to such an undertaking of street widening and extension, but it considers that advantages directly derived therefrom by the city at large and by individuals will more than offset the expensive improvement costs. The city is to bear a reasonable proportion of the cost of the improvement and contiguous property will as well bear its share.

It has been ascertained that the assessed valuation of the entire property affected in any way by the widening is approximately $3,000,000. While no assurance can be given as to the cost of the improvement the City Plan Commission judges that it should not exceed this valuation, considering that in many places the widening does not materially damage the property itself. The procedure which would be undertaken in case the Common Council decides favorably on this recommendation is by condemnation proceedings, and every property owner would have an opportunity to present to a jury his claim for the damage done to his property.

This is the first extensive street widening problem which Detroit has had to face. However, it is considered easy to accomplish from an engineering standpoint. The exact work that will have to be done in case



DETAIL AT MICHIGAN CENTRAL STATION



CLEVELAND-WATERLOO CONNECTION

the Common Council will approve the entire project will be to widen Michigan Ave. at 14th St. to 80 ft. connecting with Gratiot Ave. at Riopelle St.; extend Dix Ave. and open it into 18th St. at the subway beneath the Michigan Central tracks at the new station—the route will be along the west side of the new park in front of the station to Michigan Ave. and will connect with High at 14th St. East of Riopelle St. the route will follow Gratiot Ave. across Bequindre nearly to St. Aubin; thence along Cleveland St. which will be opened and widened to Bellevue Ave. where it will connect with Waterloo St., which is also to be widened and straightened. The Common Council has approved the opening and widening from 14th and Michigan Ave. easterly, and it is thought that the project will be approved in its entirety in the near future.

Various types of paving, including sheet asphalt, creosoted block, vitrified brick, and cedar block, are surfacings now covering parts of the proposed thoroughfare, though officers of the City Plan Commission assert that in case the project is approved sheet asphalt will most likely be used, though no definite decision upon that point has yet been made. It will likely take several years to complete the project.

Timber Arch Bridge of Unusual Type in Service Seventy-Three Years

AFTER 73 years of service an unusually interesting wooden bridge at Lowell, Mass., carrying Broadway over the Pawtucket Canal, has been replaced by a steel arch structure. Increasing street-car loads rather than decay brought about the replacement. The structure was of a type not suited to concentrated loading, though for a number of years it has carried street cars in addition to the regular vehicle traffic of a main street.

Built in 1846 by the proprietors of the locks and canals, the bridge dates back to the early days of the Merrimac River canal system, of which the Pawtucket Canal is a constituent part. It stood almost without repair until 1917. Up to a year ago it was of the single-arch form shown by the view Fig. 1 and the upper

FIG. 1. DOWNSTREAM SIDE OF BROADWAY BRIDGE OVER PAWTUCKET CANAL, LOWELL
(View in 1915 before addition of secondary arch system)

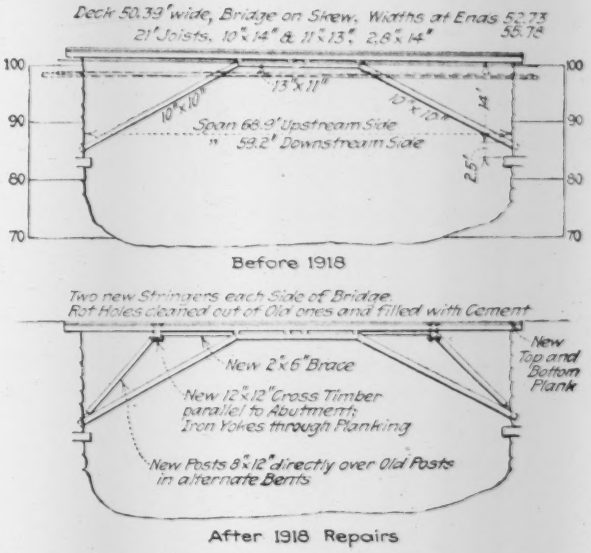

Deck 50.39' wide, Bridge on Skew. Widths at Ends 52.73 55.74
21" Joists. 10"x14" & 11"x13". 2.8"x14"
100
90
80
70
13"x11"
10"x10"
Span 68.9' Upstream Side
" 59.2' Downstream Side
2.5'
Before 1918
Two new Stringers each Side of Bridge
Rot Holes cleaned out of Old ones and filled with Cement
New 2"x6" Brace
New 12"x12" Cross Timber parallel to Abutments; Iron Yokes through Planking
New Posts 8"x12" directly over Old Posts in alternate Bents
New Top and Bottom Plank
After 1918 Repairs

FIG. 2. SKETCHES SHOWING CONSTRUCTION OF BROADWAY BRIDGE AND 1918 STRENGTHENING

sketch in the drawing, Fig. 2. The span of the structure varies from 64½ ft. at the downstream side to 73½ ft. at the upstream side, the abutments being not parallel.

As will be seen, this structure is a three-segment rib arch and therefore is not of rigid type. Its stability under unsymmetrical loading depends on the stiffness of the joints and the stiffening action of the stringers or floor joists. In 1917 and 1918 the floor was repaired and at the same time it was considered necessary to reduce the flexibility of the structure under street cars. For this purpose a secondary arch system was inserted, as shown in the lower elevation in Fig. 2. The work was carried out by the canal company with the co-operation of Stephen Kearney, city engineer of Lowell, on whose authority the preceding information is given. The revision was only a war-time expedient, however, and during the current year the bridge was replaced by a steel structure, as previously stated.

Determining Bearing Power of Soils

With a view to determining the physical characteristics of various subgrade soils, thereby obtaining a scientific measure of their bearing value, an investigation is now being carried on by testing engineers within the Bureau of Public Roads. The work includes taking samples of soil at spots in the subgrade of highways where failure has begun, and studying surrounding geological conditions to determine in what manner moisture reaches the subgrade, thus destroying its value.

In this investigation it is hoped that co-operation will be secured from various state highway departments. The Bureau of Soils is co-operating with the Bureau of Public Roads in the investigation.

So far samples of soil have been taken from the Washington-Baltimore Road in Maryland, and are now under observation. Later the work will be extended beyond Baltimore and on other roads in Maryland. Some progress has been made in laboratory testing, a number of samples of subgrade material having been examined already.

Report on Test of Two-Way Tile and Concrete Floor

Preliminary Results of Stress-Deformation Records Made on Experimental Structure by Bureau of Standards

ONE of the most extensive stress-deformation tests on a full-size structure has recently been completed by the Bureau of Standards on a specially built two-way tile and concrete floor. While complete results have not been worked up, it is possible now to give a preliminary report of the test, from data obtained from W. A. Slater, of the Bureau of Standards, who had charge of the work. The structure was built by and the tests made for J. J. Whitacre, of Waynesboro, Ohio, and Prof. R. H. Danforth, of the Case School of Applied Science, co-operated in the tests.

The purpose of the test was to obtain data which would afford a basis for the design of a two-way reinforced-concrete and hollow tile floor system. The test was planned to obtain information on (1) the effect of variation in the ratio of length to width of panels on moments in two directions, (2) the relation of maximum negative moment to maximum positive moment, (3) the distribution of stresses in the reinforcement, the concrete and the tile at points of maximum positive and negative moment, (4) the deflection of the slab and girders under different loadings and (5) the anchorage of bars required for negative reinforcement.

For the purpose of obtaining the data desired, a large slab was constructed upon which strain measurements were taken on approximately 900 gage lines in the reinforcement, 500 gage lines in the concrete and 75 gage lines in the tile. Deflection was observed in 40 places.

The slab is 117 ft. 6 in. long and 50 ft. wide, and is divided into 18 panels. Six of these panels are 16 ft. square, six are 16 ft. by 19 ft. 3 in., and six are 16 ft. by 22 ft. 6 in. These panels are supported by reinforced-concrete girders, the stems of which are generally 12 in. wide, making the clear spans of the slabs about 12 in. less than the panel lengths and widths as given above. The slab, whose total thickness is 6 in., is made up of 6 x 12 x 12-in. clay tile laid in such a manner as to form rows in two rectangular directions with 4-in. ribs of reinforced concrete between each two rows of tile. The ends of the tile were left open, allowing a small amount of concrete to enter the cells so that they form an integral part of the slab.

Each concrete rib throughout the slab has as reinforcement one ½-in. plain, round bar extending the full length of the rib. The center of the reinforcement extending in the short direction of the panel is about 1 in. above the bottom surface of the rib and the reinforcement extending in the long direction is about 1½ in. above the bottom surface of the rib. Over the support in each rib is one ½-in. plain, round bar whose center is 1¼ in. below the top of the rib. This rod extends to a point one-fourth of the span length from the support.

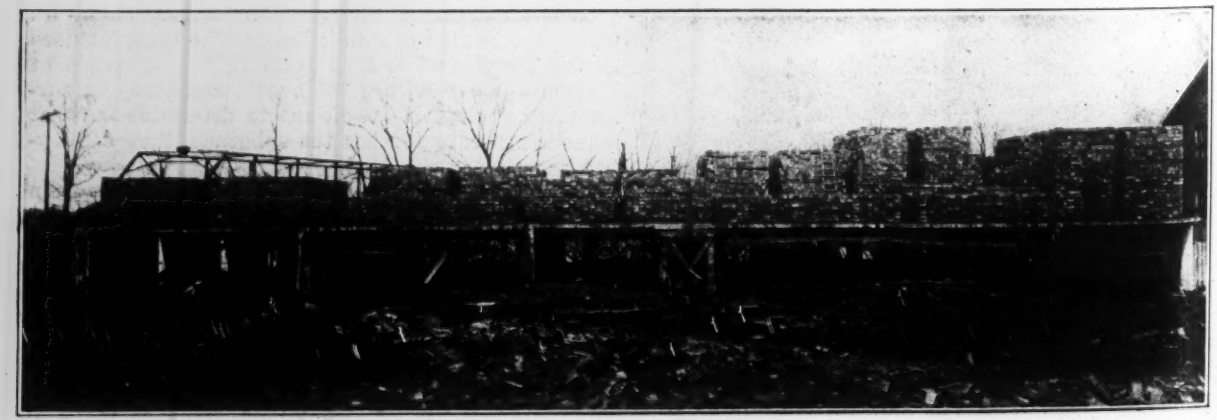
Loading the slab began on Dec. 20, 1919, and continued at intervals up to Feb. 5, 1920. At this time the applied load on the square panels was 397 lb. per square foot, on the intermediate size panels 280 lb. per square foot, and on the long panels 230 lb. per square foot. This load was allowed to remain in place until April 3, 1920. Under this loading the stresses in the reinforcement at points of maximum negative moment were 40,000 to 50,000 lb. per square inch. The stresses in the reinforcement at points of maximum positive moment were less than 12,000 lb. per square inch.

The load was then shifted from one part of the slab to another in order to secure relatively high stresses in the steel resisting positive moment in typical panels. On April 20, 1919, when the stresses in the positive steel in typical panels were over 30,000 lb. per square inch, the load on an interior square panel was 730 lb. per square foot, on an interior intermediate panel, 615 lb. per square foot and on an interior long panel, 505 lb. per square foot. The loads on typical exterior panels of each size were approximately 70 per cent of the load on interior panels of the same size.

The data of the final loading which so far have been worked up, show:

(1) The tile was effective in resisting compressive stresses, the deformations observed in the tile being approximately 70 per cent of the deformations in the concrete;

(2) The negative bending moment for interior square panels based on maximum weighted stresses observed after the load of 397 lb. per square foot had been in place about two months was less than $1/44\ Wl$ for all panels and the average was considerably less than this; in this formula W is the total load on the



TEST FLOOR MADE UP OF TWO-WAY TILE AND CONCRETE CONSTRUCTION

panel in pounds and l is the clear span length in inches;

(3) Positive bending moment for an interior square panel, based on maximum stresses observed under the load of 730 lb. per square foot, was about 45 per cent of the negative bending moment:

(4) The negative bending moment for exterior square panels based on stresses, observed after the load of 372 lb. per square foot had been in place on the panels for about two months, was about 20 per cent more than that for interior square panels;

(5) The positive bending moment for exterior square panels was about 25 per cent more than that observed for interior square panels.

Complete results have not, as yet, been worked up for the negative and positive bending moments for the oblong panels, the point of inflection, deflections under different loadings, vertical shearing stresses, etc.

New Contract Provisions Proposed

Labor and Materials Cost Variations Covered in 16 Clauses Recommended by Contract Committee of A. G. C.

As a result of a study, during the past year, of 113 different forms of contracts of various types, the committee on contracts of the Associated General Contractors of America has approved 16 provisions which it recommends be included in every contract made by members of the Associated General Contractors. Although the committee is not yet prepared to submit a complete form of contract, embodying every provision which it believes should be included in a good contract, it has recommended immediate adoption of certain clauses, including those to take care of variations in the cost of labor, materials and freight rates. Another provision covers reduction in the amount of surety bonds from time to time during the execution of the work, so that the bond will cover only the uncompleted portion of the work.

The 16 provisions recommended are given herewith:

1. *Action on bids.* Bids should be submitted with the provision that they must be acted upon within a reasonable time.

2. *Freight rate changes.* Bids should be submitted on the basis of existing freight rates, with the provision that in case a change in rates should occur between the time bids are received and the date fixed for the completion of the contract, the contract price should be increased or decreased accordingly.

3. *Wage scale changes.* Bids should be stated and be submitted on existing wage rates, with the provision that the contract price shall be increased or decreased in accordance with any change in such rates before the date fixed for the completion of the contract.

4. *Material price changes.* Bids should be submitted on the basis of existing prices for materials f.o.b. the producer's plant or distributor's yard, with the provision that the contract price shall be increased or decreased in accordance with any change in such price that takes place within the time allowed the contractor to purchase and fabricate his material.

5. *Monthly estimates.* Monthly estimates should include materials delivered and suitably stored as well as materials incorporated in the work.

6. *Partial payment.* Certificates should be prepared and delivered to the contractor between the first and the tenth day of each month, showing the proportionate parts of the contract price earned during the preceding month. These certificates should be paid by the owner by the 10th day of the month. Interest on the first payment should be made the contractor at the prevailing rates.

7. *Contractor's right to stop work.* Under the following conditions, the contractor should have the right to stop work or terminate the contract upon three days' written notice to the owner and the architect, and recover from the owner payment for all work executed and any loss sustained upon any plant or material, and reasonable profit and damages;

(a) If the work should be stopped under an order of any court, or other public authority, for a period of three months, through no act or fault of the contractor, or anyone employed by him;

(b) If the architect or engineer should fail to issue the monthly certificate for payment in accordance with the terms of the contract;

(c) If the owner should fail to pay the contractor, within seven days of its maturity and presentation, any sum certified by the architect or engineer or awarded by arbitration;

(d) If the owner does not permit the contractor to proceed with construction within a reasonable time after signing the contract.

8. *Retained percentage.* The retained percentage should be based on 100 per cent of the work performed and should never exceed 10 per cent. When the amount retained reaches a total sum, which shall be mutually agreed upon by the owner and the contractor, no further reduction from payment should be made.

9. *Surety bond.* When a surety bond is given, it should be reduced at agreed intervals so as to cover thereafter, only that portion of work left uncompleted.

10. *Penalty clauses.* Whenever any provision is incorporated in the contract for a penalty against the contractor (including liquidated damages), there should also be inserted a provision for a bonus of like amount.

11. *Act of God or a public enemy.* The contractor should not be held liable for results arriving from the act of God or a public enemy.

12. *Time allowed for completion of work.* The time allowed for the completion of the work should be based on "weather-working" days instead of on elapsed time and, if necessary, allowance should be made for time spent in performing unproductive work, made necessary by flood or other natural causes beyond the control of the contractor.

13. *Inspection.* Where practicable, material should be inspected at the source so that possible delay may not result from the rejection, at the site of the work, from material furnished in good faith to the contractor.

14. *Force account work.* Payment for force account work should be made on the basis of the total actual profit of the work, including the actual labor and material cost, rental on equipment, liability insurance, etc., plus a reasonable percentage to cover overhead and profit, total to be not less than 15 per cent.

15. *Change in quantities.* In case the actual quantity of any item in a unit price contract is less than the estimated quantity by more than a certain fixed per cent, the unit price paid the contractor for that item should be increased by an amount to be agreed upon. Similarly, a decrease in the unit prices should be made in case the quantity is increased over the estimate by more than a certain fixed per cent.

16. *Arbitration.* In no case should the engineer or architect be made the final judge as to the interpretation of the drawings and specifications or the performance of the contract. All decisions and interpretations should be subject to prompt arbitration at the choice of either party to dispute.

The contract committee, whose recommendations, indicated above, were printed in a recent issue of *The Bulletin* published by the Associated General Contractors of America, is headed by J. W. Cowper, the other members of the committee being: Arthur Bent, Bent Bros., Los Angeles; M. L. Cunningham, Municipal Improvement Co., Oklahoma City; Avery Brundage, Chi-

cago; D. G. Goggin, Fred T. Ley & Company, Springfield, Mass.; L. S. Oakes, Winston Bros. Co., Minneapolis; J. W. Rollins, Holbrook, Cabot & Rollins Corp., New York City; and E. Stanley Holland, Bates & Rogers Construction Co., Chicago.

Nitrate Plant Construction Both Scored and Praised

SELECT Committee on Expenditures in the War Department, of the House of Representatives, has issued another of its subcommittee reports on the investigations in which it has been engaged for some months past. This one—the work of Subcommittee No. 5 on Ordnance—is the result of the hearings "upon the activities and expenditures of the President and War Department in their efforts to build and operate plants for the manufacture of nitrates for the winning of the war." Like its predecessor on cantonment construction, noted in these pages some weeks ago, it is strictly a partisan performance, the majority report condemning every act of the Administration being signed by two Republicans, and the minority report denying every allegation of the majority, by one Democrat.

The plants in which nitrates were to be made by the Government comprised Nos. 1 and 2 near Sheffield, Ala., on the Tennessee River by the famous Muscle Shoals, No. 3 at Toledo, Ohio, and No. 4 near Cincinnati, Ohio. No. 1 was an experimental plant authorized by the National Defense Act of 1916, which appropriated $20,000,000 for the purpose of the manufacture of nitrates, though the selection of the site was not decided upon nor work started until after the United States was in the war. It involved also the construction of the since named Wilson dam across the Tennessee River at Muscle Shoals and the projected construction there of a hydro-electric power plant. Plants Nos. 2, 3, and 4 were built under the War Emergency Act and the sites selected subsequent to the beginning of plant No. 1. Plants Nos. 1 and 2 were completed before the armistice but never supplied any product for war purposes. Plants Nos. 3 and 4 were shut down after the armistice after about $7,000,000 had been expended on each. Construction of the Wilson dam was shut down for a time toward the end of the war due to the difficulty in obtaining priority for material for it, but work was recommenced just before the armistice and is now under way.

The majority report contends that the whole nitrate program was one of misdirected effort; that the labor and money required to construct the nitrate plants could have been utilized better in producing food or other war essentials; that there was no necessity at any time which required the War Department to embark upon the building program for the manufacture of nitrates for war purposes, but that it should have early in 1916 purchased and stored in this country sufficient Chilean nitrates to last during the war; that "the excuses given for the program that German submarines might possibly cut off our supply of Chilean nitrates or that Chilean nitrate producers might raise the price thereof was visionary and not justified by the facts"; that the selection of Sheffield, Ala., and Muscle Shoals, was in effect merely a concession to numerous interests which had been for years trying to induce the National Government to dam the Tennessee River for the production of hydro-electric power at this point; that the contracts made by the War Department with the Air Nitrates Corporation, which had charge of the construction of the last three plants, are unilateral and unfair and unjust to the Government; that the ordnance officers charged with the responsibility for the plants failed in most instances to guard the interests of the United States; that the Ohio sites were entirely unsuitable for the location of such plants; that they were merely selected to appease the Ohio delegation in Congress which was strenuously objecting on the floors of Congress to the selection of the Southern site; that the cost-plus system of contract caused great additional expense to the Government and had a demoralizing effect upon the labor of the country and delayed completion of the plant; that there was excessive waste in labor and materials caused by neglect and inefficiency or wilful intent of the contractors; that there was a careless and wilful disregard and destruction of property purchased with public funds; that the work of construction on the plants was inefficiently conducted. Finally, the majority recommends that plants 1, 3, and 4 be abandoned, and plant 2 (Muscle Shoals) be leased.

The minority member denies in toto all of the contentions of the majority which reflect upon the judgment and performance of any of the officials or officers connected with the projection or construction of the nitrate plants. He says that a proper consideration of possibilities made imperative the independence of the United States in the production of nitrates; and that the charge that the Government did not store up Chilean nitrates is in effect a charge against Congress which did not provide the funds for such purposes. He contends that the strictures on the Wilson dam and on plant No. 1 are not pertinent because these plants were authorized before the United States was in the war and were in effect merely a necessary preparation against possible contingencies either for peace or war necessities of nitrates, the former for fertilizers, the latter for explosives. He defends in set terms the contracts between the Government and the Air Nitrates Corporation, and also the integrity of the officers and contractors connected with the construction. The minority member finally refuses to accede to any recommendation as to the future of the plants because there is a bill before Congress and in the hands of another committee.

The only issue on which both majority and minority agree is that the Alabama Power Co. took advantage of the Government's necessity to enlarge facilities of their plant at the expense of the Government.

New Highway Laws for Finland

After operating for 35 years under regulations stating that highways and village roads are to be "constructed and maintained by those who need them" the national government of Finland has passed a law which goes into effect Jan. 1, 1922, whereby roads are to be classified and a large percentage of the 30,000 mi. is to form a national system. Under the new law all roads will be classified according to administration as highways administered directly by the State, those maintained at State expense, and local roads. Highways forming what will be known as first class roads will be those from 19 to 23 ft. in width; second class, 16 to 20 ft. and village or local roads not less than 10½ ft.

LETTERS TO THE EDITOR

Shall Chinese Labor Be Imported?

Sir—In the May 6 issue of *Engineering News-Record*, p. 926, you published a letter by me bearing on the subject of how best to meet the serious conditions existing and confronting this country on account of the shortage of common labor, and the high cost of living. A similar letter was sent to every member and associate member of the American Society of Civil Engineers, about 2000 in all.

By May 15, more than 1,000 answers had been received representing every State in the Union. These letters were classified and the results are herewith presented. Additional answers to my letter being received daily, the presentation of the final results will be deferred to a later date.

For importation of Chinese labor	608
Favorable to such importation	74
For immigration, exclusive of Asiatics	86
For increase of labor-saving machinery	10
Neutral	95
Against any immigration	101
Waiting for further information	28

Those who expressed themselves for importation of Chinese labor were strongly in favor of concerted action for a modification of the Exclusion Act and many were for amending the present drastic immigration laws.

Those against Chinese or all immigration, while admitting that we were facing a most serious labor situation, offered as a solution, some the introduction of more labor-saving machinery, others the bringing about of better efficiency of the labor now available and increasing the working day to ten hours or more, and still others the closing down or curtailing of all non-essential industries until conditions shall have improved. Comments on these various suggestions are withheld for the present.

Such a large majority of the writers expressed themselves in favor of and urged that a concerted action be taken by the engineering fraternity to solve this difficult problem, that we have decided to organize the "National Immigration Council," whose purpose it will be to carry on an educational campaign with the American public, showing the necessity for action and what that action should preferably be. This, of course, will require the co-operation of patriotic and influntial men in every State and a beginning is being made among the Engineers to have such men serve on an Advisory Committee.

Chicago. JOHN ERICSON,
Consulting Engineer.

Sir—I have just noted Mr. Ericson's circular letter requesting an expression of opinion as to the advisability of importing Chinese, under restrictions, to supply the demand for unskilled labor. I am opposed to the importation of the Coolie class of labor because I believe that it is morally and economically unsound in principle.

I believe that it is morally unsound to use any people to do the work of another people in the country of the latter. When the American people cannot do their own work from bottom to top it will indicate a decadence and a dependence upon a race of workers, and history has shown that only the worker races survive. America has been made what it is the most progressive country, by Americans of the pick and shovel, axe and scythe, pioneer-frontier type. The pick and shovel American is respected in the West even today. A man is not of the type of Americans who made America what it is, unless he has eaten his peck of dirt and served his time on the shovel, pick and barrow handles. It does not make any difference how well-to-do you or I or any other man may be, that does not excuse our sons from doing their share of the world's physical labor. It is the moral duty of the physically and mentally sound to do some productive labor. It is the moral duty of the younger generation to do the hand labor that they may better fit themselves to do the head labor. A race of strong men is not made by gymnasium exercise; it is made by physical labor; it perpetuates itself by physical labor; and, it becomes decadent and finally extinct without physical labor. We can easily recall many famous Americans who builded the foundations of their successful lives with the pick and shovel in their own hands.

It is economically unsound to import Coolie labor to do our work because our work cannot be done for us, as a whole, more economically than we can do it for ourselves. If we have Coolie workers, we will have American idlers An idle, non-productive man is a parasite, no matter how many Coolies are used in his place. It is not economically sound to encourage the parasites and discourage the workers of any country. There is no labor that is menial except in the minds of the parasites and the unlearned. When we import Coolies to do our labor, we put our workers in the class of Coolies automatically. Our shortage of labor today is due largely to the fact that cheap labor has been imported, in the past, and put to work along side of young Americans, thus degrading our own people and betraying their loyalty as workers. It was a short-sighted policy then; it may complete the damage beyond repair if we do not look wholly to our own people to do our own work henceforth.

Instead of invoking the law to permit the importation of Coolie labor I would have the law define the crime of idleness and the punishment thereof. For an immediate solution, I would put the question up to the young manhood of this country. An efficient labor bureau in the Department of Labor could do this. Groups of young men are easily accessible in the colleges and high schools. Ask them whether their backs are so weak that we must import and sustain a Coolie class to do their work. I know what the response will be. I have seen them use picks and shovels, scythes and pitchforks, axes and mauls. Some of them, now world famous and honored, I have seen with calluses on their hands as thick as sole leather.

Shortly the colleges and high schools will close for the summer vacation. What systematic effort, what effort of any kind, is being made to use this man-power? Thousands of these young men are looking and will be looking for a job of most any kind for the vacation. Why should they waste their time seeking employment? Why is not the Department of Labor empowered to secure employment for these willing workers? These young men can and will revive the dignity of labor if you put the proposition up to them and back them loyally, but you cannot be loyal to them and put them in the class of coolies.

Revive the dignity and loyalty of labor in this country by loyally backing the young manhood of this country against cheap labor of the coolie class and you will have a plentiful source of physical workers.

Lakeport, Cal. . . A. KITTS,
California Highway Commission

Sir—Concerning the importation of Chinese labor, proposals similar to Mr. Ericson's are being brought forward quite frequently at present. It seems to me that we have had enough experience with immigration to teach us that there are more important considerations than immediate labor supply. The immigration we encourage at present will to a large extent determine the character of American civilization. To adopt the proposals made in this letter would tend strongly toward a permanent stratification of the population of this country. It is generally admitted that Chinese laborers would not be absorbed into the population, and we would be starting a race problem all over again.

Unless the passion for rapid growth can be subordinated to consideration for a final well-being of the country, the political and social standards upon which America was founded will be seriously jeopardized. "The pick and shovel and wheelbarrow man" of today if a Chinese Coolie, will be the serf of tomorrow. Just at the time when the rest of the world is shaking itself free from feudalism is a poor time for America to adopt a feudal policy.

Dayton, Ohio. ARTHUR E. MORGAN,
President, Morgan Engineering Companies

Sir—The proposition submitted by Mr. Ericson in *Engineering News-Record* of May 6 p. 926—to admit Chinese labor for the relief of the existing serious shortage of labor—is one that should appeal to unprejudiced persons as eminently beneficial. The only adverse argument worthy of consideration would seem to be the antagonism that might be met from labor through fear of the effect on wages. To throw open our doors without let or hindrance to large populations having lower standards of living than we have would indeed be a questionable policy, but with due restrictions—which, to avoid the appearance of favoritism, might well apply to all nationalities by basing the limitation on a percentage of the existing naturalized population of each nationality—and with some provision for their suitable distribution throughout the country in accordance with the demand, the result would seem to be only beneficial to the laborer as well as to the country at large.

The Chinese laborer has the reputation of being a hard-working and faithful workman and if admitted in numbers merely sufficient to restore an economic equilibrium between demand and supply, would provide one of the most important of the several factors essential to a return to reasonable living conditions—a matter now so earnestly desired—and at the same time add impetus to the construction of public works.

New York City. KENNETH ALLEN.

Sir—There is no doubt that we are experiencing a marked shortage of common labor on construction work, but I am not satisfied that the remedy lies in the importation of Oriental labor. In fact, even though it is decidedly inconvenient at present and even though much construction work may be delayed or even abandoned because of this shortage of common or unskilled labor, I am afraid that the remedy suggested might prove very much worse than the disease.

Even if it were possible to introduce large numbers of Oriental laborers into this country without depressing American standards, I do not think it would be desirable to do so. The one great force that has done so much to develop American inventive genius is the plain fact that we Americans are naturally lazy, as regards physical labor, and that we abhor menial tasks. If there be one field in which Americans excel, it is in the invention and development of labor-saving devices, devices calculated to relieve us of the necessity for performing distasteful tasks, and as long as it remains comparatively expensive to hire someone else to relieve us of these tasks we are going to continue developing labor-saving machinery. As long as we continue our search for the method and the machine that will eliminate the last possible stroke of physical effort that can be eliminated, so long shall we be able to hold our own against the world.

But suppose that we can hire Oriental laborers to perform the menial and the arduous tasks at comparatively low wages; what incentive is there left to produce more labor-saving machinery? Is it not true that, regardless of what natural resources are available, those countries which have the most plentiful supplies of cheap labor are the countries which are making the least progress?

Then there is the question of efficiency. I have had no practical experience with Chinese laborers but I do know that the mere fact that wages are low is no proof that the cost of the work done will be low. Even without any increase in their standards of living, Chinese laborers would have to receive a higher money wage in America than in China. Would not their cost, figured against their units of production, be greater than Americans or Europeans? While I have no doubt that an effort would be made to regulate the importation and employment of the Chinese so that they would not, by their competition, force down the standards of American labor, I do not believe it could be prevented.

The law of supply and demand governs the sale of labor-power as well as of all other commodities. If a sufficient supply of Chinese labor is available and can be bought on the basis of a wage sufficient to maintain a Chinese laborer, probably without family, on his own standard of living, who will purchase labor-power at a price high enough to support an American with a family?

CHARLES F. DINGMAN,
Engineer, Flynt Building and Construction Co.
Palmer, Mass.

Sir—Mr. Ericson's letter discussing the shortage of unskilled labor, brings up a point of vital interest. Some of the experiences in the Pacific Coast states, with laborers from the Orient have been so unfortunate that one can scarcely blame their inhabitants for not taking kindly to the thought of an extensive new "invasion." Of course the ground of strictest justice is to make one set of immigration laws to cover all colors and kinds, health, educational and financial qualifications. Then let normal laws work. Demand will produce supply, if legislatures and congress and commissions without end do not in their usual positively stupid way interfere.

The New York legislature adjourned a month ago, leaving many more than 1,000 bills passed, as a record of its activity. Does anyone imagine that any large percentage of these possible laws have any real necessity for existence? The Governor will veto many, but why pass them? Often because some good man or woman sees some special trouble, rushes a complaint to an Assemblyman or Senator; a bill is drafted, almost unnoticed it slips along; and—another law exists.

Equally, labor legislation, good or vicious, slips through, bringing in its train some special betterment, but a whole sequence of unfortunate results. Education, Christian treatment of others and standing up for the real dignity of labor, not its so-called "rights," will alone cure the conditions from which we are all suffering.

Immigration is once more beginning and in time will help relieve the difficulties; I doubt whether the Chinese solution would result well. It would be somewhat in the nature of employing strike breakers, which, though sometimes justified, is not always the best or most successful way in the long run.

Sometimes positive action is essential. I believe, however, that in the present labor question, dignified inaction may produce the best result, through operations of normal law.

New York City. LOUIS J. TRIBUS, Consulting Engineer.

Prohibition and the Foreign Born

Sir—I have been endeavoring to answer the editorial which appeared in your issue of April 15, p. 747, under the heading "Prohibition and the Foreign Born." My company is very much disappointed to see such an article in your estimable paper, which we read weekly.

This great country of ours has been placed under prohibition because manufacturers and business men have to a very large extent taken part politically and financially to bring this about. One of the maxims of industry is "Safety First." The duPont Powder Company has discharged all drinking employees. A powder mill is no place for an unsteady hand and an inflamed eye. A big manufacturer who has come up from the ranks of labor recently said: "Whiskey is the monkey-wrench in the machinery of industry." This is why the Carnegie Steel Company, the United States Steel Corporation and all kinds of industry and business have helped to wipe this curse of liquor from the map. The results already show that crime, poverty and the lowest diseases everywhere are diminishing and the working man who used to be absent on Mondays and Tuesdays because of his Sunday debauch, is now on the job regularly.

Commenting on the quotation from Professor Leacock of McGill University, Montreal, I would like to state that prohibition is increasing efficiency and it is reasonable to believe that commercial competition will naturally and inevitably cause other nations to adopt our policy. Drunken Europe can never compete with sober America. The "dry" provinces of Canada will compel Quebec to go dry and some day the people of Quebec will also realize the favor that was done them.

So far as prohibition might operate against immigration, we feel that the benefits which America offers to the foreign born far outweigh the "disappointment" which he may experience by the absence of liquor, and the wife of the laboring man is thankful to get to a place where the weak determination is helped by making it impossible for the bread earner to get the liquor.

We are for prohibition all the time, and will exert ourselves politically and financially to maintain the law.

Philadelphia. THOMAS C. SATTERTHWAIT,
Secretary, Shoemaker-Satterthwait Bridge Co.

Sir—Anent "Prohibition and the Foreign Born," the very able editorial which has aroused the ire of Edgar Dow Gilman (May 6 issue, p. 927), I desire to say that an experience of nearly thirty years in handling men in various occupations, over twenty of which have been spent in contracting and engineering lines leads me to concur in your statement that it *is* a problem to be investigated.

Mr. Dow, in common with many advocates of so-called efficiency, fails to give the human equation its proper value in the scheme of things. These reasoners are for the most part, men who have not mingled intimately with their fellow men and cannot realize the trials, tribulations and tastes, of the "common peepul." As laborer, foreman, inspector, superintendent and employer, it has been my very great fortune to have been thrown close to my brother workmen and I have many times seen the ragged edge smoothed down through the humanizing influence of a friendly drink. The laborer is not a man with highbrow tastes in the choice of his enjoyments and after his day of bone-breaking, ambition killing, monotonous work, his glass of ale at quitting time has given him the relaxation his body needed. It has caused him to forget the trifles that caused him annoyance.

The saloon has many unfavorable attributes, certainly, but it was the workman's gathering place and club. Such a place is essential to the genus homo. The habits of people, transmitted through many generations, may not be broken abruptly without upsetting the entire domestic situation. Men do not readily pick up new schemes of life or enjoyment, no matter how desirable from a social or "efficient" point of view, and the attempt so to do results only in unrest and consequent loss of the little efficiency gained by keeping the men as comfortable in mind and body as circumstances permit.

Mr. Dow announces just who put the eighteenth amendment across. This statement of his many deny. He seems to think that all those men who stayed at home during the war are the efficient ones; that the opinions of four and one-half millions of voters were not consulted and of these most were not cognizant that there was any such movement on foot except the very proper war-time prohibition for the conservation of resources.

"Efficiency"!! Oh what is not perpetrated in thy name? "Efficiency," like charity "covereth a multitude of sins."

There can never be efficiency by law. Efficiency only comes through the comprehensive understanding and tolerance of the frailties and foibles of the common man as well as a just recognition of his many, many good qualities. I believe in men and I believe that they are most amenable when least interfered with in their pursuit of life, liberty and happiness.

Wilkes Barre, Penn. EUGENE BEAUMONT.

Sir:—I do not agree with your correspondent, Lewis D. Rights (April 22 issue, p. 831), that prohibition has not affected foreign-born labor. Through personal contact with Italian laborers I can say positively that they are and have been leaving the United States on account of prohibition. It may be true that Italian immigrants are returning to this country, but I doubt whether they will do the pick-and-shovel work which we need. It also may be true that prohibition was legally passed *by reason of* all the "checks" provided by an "anti-saloonatic league."

We do not build a single track railroad, and wait for the "effect" on the community, when we know that a double-track line, will be necessary in "three months;" but some of us can sit in an office and figure with a single-track brain.

Rockville Center, N. Y. WALTER G. FEDERLEIN,
Construction Engineer.

Sir—My attention was attracted to your editorial "Prohibition and the Foreign Born," appearing in your April 15 issue, by the letter of Edgar Dow Gilman relative thereto, appearing in your issue of May 6. If you desire to present facts, I suggest something more creditable and convincing than quotation from liquor propaganda. Mr. Gilman's reference to the great labor unrest in England, where there is no eighteenth amendment, is pertinent. One of the well established economic facts in this and other countries, including England and Germany, is that the drinking which wage earners do wherever liquor is available materially depreciates the reliability and value of the labor and increases the cost and decreases the output of the product.

Some of our captains of industry may object to the eighteenth amendment for themselves but they are, I believe, as a rule, favorable to its application to their employees. Certainly they do not, and with good reason, want their employees to come to the plant under the influence of liquor. For years they have been endeavoring to push the saloon away from the plant door. The logical end is nothing short of the eighteenth amendment.

Giving back liquor to the wage earners would be, in my opinion, economic folly. Contentment of labor, if such contentment exists, due to drinking liquor is the result of "soused" insensibility to low standards and conditions of living. Such a laborer is not the typical American workman who, in years gone by, helped to make the efficiency and greatness of American industry. Is it your view that the future of American industry is dependent for its labor supply on the beer and wine soaked dregs of Europe? Have you overlooked the recent poll by the *Literary Digest* of American labor, showing a big majority favorable to prohibition?

El Paso, Tex. J. L. CAMPBELL,
Chief Engineer, El Paso & Southwestern System.

Stealing Labor

Sir—I have read with considerable interest the editorials "Stealing Labor" and "Looking at the other Fellow's Job," which appear in the *Engineering News-Record*, May 6, p. 889.

This National Association of Building Trades Employers feels that propaganda of this sort should be spread broadcast and often. We feel so strongly on the matter of contractors endeavoring to make their work attractive by added compensation in the shape of "overtime," "bonuses" and "expenses" that we are constantly watching these matters and correcting these pernicious practices whenever and wherever we find them among our membership.

The following resolutions were passed at a recent meeting of the association and I would feel indebted to you if you would give them publicity:

"Whereas, The lack of apprentices in the building trades is being seriously felt at the present time on account of scarcity of competent mechanics to do building construction work, and

"Whereas, The necessity for providing mechanics is apparent to those engaged in the industry and should receive the early and serious consideration of all contractors; therefore be it

"Resolved, That the members of this Association be instructed to use every means possible to encourage the young men in their respective localities to enter apprenticeships in the numerous building trades.

"Resolved, That it is the sense of this meeting that overtime work is detrimental to the interests of the building industry, and that every effort possible should be made by contractors in all parts of the country to discourage the practice, except in emergency cases."

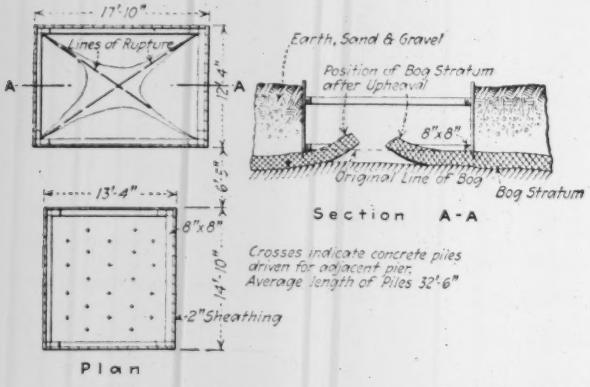
The above resolutions have been sent out as orders to the various member associations.

F. G. WEBBER,
Executive Secretary, National Association
of Building Trades Employers.

An Effect of Pressure-Transmission on Soft Soil

Sir—A condition of soil swelling, somewhat unique, was observed recently during the pile-driving for the foundations of the Metropolitan Life Insurance Co.'s Printing Building at Thompson Ave. and Court St., Long Island City.

Pits for concrete foundations were sheathed with 2-in. plank, carried down to the top of an old bog. When the piles were driven for the first footing it was noticed that this bog layer ruptured in the center of an adjoining pit. The swelling caused the bog layer to heave up in pyramid form as indicated in the accompanying sketch. The sheathing did not extend into the bog more than 6 in. The bottom timber holding the sheathing rested upon the bog and the obvious explanation is that this stratum failed from upward pressure. The bog layer is about three feet thick.



BOG SURFACE RUPTURED BY TRANSMITTED PRESSURE CAUSED BY PILE-DRIVING

WM. T. QUINN,
Superintendent, Turner Construction Co.
New York City.

Panama Canal and Arkansas Razor Backs

Sir—Referring to article "Panama Canal and Arkansas Razor Backs—a Feat in Mathematical Gymnastics," by R L. Kirkpatrick, appearing in your issue of April 29, p. 874, I wish to suggest that Mr. Kirkpatrick's calculations are based upon an erroneous conception of the qualifications of the Arkansas hog. These hogs, as the name implies, not only "buck the line," but they "go through." No reliable result can be determined by comparing the power of the Razor Back with the casual rooting of the Iowa or Illinois swine.

A proper solution would be to take the cross-section of a composite hog and multiply this by an earthquake and volcanic factor, representing his dynamic force. If Mr. Kirkpatrick will compute this, he will see that not only is the Arkansas Statesman sustained, but that a sea level canal would thus be provided and the Culebra slides made impossible.

Bridge Junction, Ark. H. N. PHARR
Chief Engineer, St. Francis Levee District.

Leaky Cross-Connections

Sir—Perhaps it was not so intended, but the reference in the last paragraph of the editorial on "Leaky Cross-Connections" in your issue of May 13, p. 939, might readily give the impression that fire protection engineers generally were in favor of cross-connections between two supplies, one of which is unsafe or questionable.

The fire protection engineer is not the responsible party in making the connection originally or in its continuance. Insurance standards require, for complete reliability, two independent sources of supply, and the plant management or the municipal authorities may, and often do, use one source which is unsafe or questionable from a sanitary standpoint, for the reason that it is a cheaper or easier one.

The engineers of the National Board of Fire Underwriters do not, and we believe other engineers should not favor such connections, but there are cases where they have already been made and it is not possible, without the charge of discrimination, to refuse credit for them as emergency sources. It is, however, standard practice with many of the insurance bureaus to recommend secondary sources of supply which will be safe, as for instance, a storage reservoir.

The double check-valve, designed some years ago for use on connections to sources of doubtful quality, has been permitted by some health authorities and has a satisfactory record. It should be installed most carefully and be maintained under a thorough inspection system.

GEORGE W. BOOTH,
Chief Engineer, National Board of Fire Underwriters.
New York City.

[We did not intend to include all fire protection engineers. The language used in our issue of May 13 was: "Unfortunately there are still some engineers, especially those in the employ of the fire insurance companies, who see no harm in cross-connections or who put property risk above life risk." We are glad to print Mr. Booth's strong statement against cross-connections.—EDITOR.]

Engineering Instructors' Pay

Sir—Your columns have contained many valuable discussions of the shortcomings of our engineering colleges. Speaking for the teachers in general we are glad to get the opinions of the men who use our products. However, it seems to me that time and ink can be more advantageously used at the present in trying to bring about certain practical changes which are much more needed than are the improvements in pedagogy. To make clear what I have in mind, consider two advertisements which have appeared recently.

"Wanted, Instructor in Civil Engineering, salary $1800 per year, one month vacation on full pay. A man is wanted who can teach drawing, mechanics, surveying, railroad engineering, and hydraulics."

"Wanted, Instructor in Civil Engineering. Salary $1800 per year. A man is wanted who can teach topographical drawing, surveying, design of framed structures, and highway engineering. A 1920 graduate will be considered."

At this time when any one who has a degree from an engineering school can get a job that will not only pay $150 per month to start, but which offers a good chance for promotion, how can a college pick up a good instructor for $1800 per year? Time was when only men who stood at the top of their class were even considered for instructors. Now the Universities must take what is left after the good commercial jobs are filled. It may be possible for a 1920 graduate of average capacity to teach five highly specialized technical courses simultaneously, but I doubt it.

The personality of the instructor, his breadth of view, the inspiring influence of his character are more important than his technical knowledge. How much of strength of character in addition to expert technical knowledge can be demanded in the present labor market for $1800 per year?

After everything has been said and done, the strength of a college does not lie in its equipment, and it does not lie in its curriculum. The preeminence of an institution lies in the personality of its faculty In the present notoriously underpaid condition of our instructors, everyone interested in the welfare of our educational system should cease academic discussions of pedagogy and lend his influence to raising the pay of the teaching profession to a level where it will attract the best of our manhood. We should get behind all efforts of this kind, notably those of Prof. C. J. Tilden's committee of the American Association of Engineers which is preparing a schedule of recommended salaries for engineering teachers. This committee includes in its membership leading engineers in all branches of the profession. Those really interested in the welfare of our engineering schools will do well to get in touch with this committee and to lend it their moral and active support.

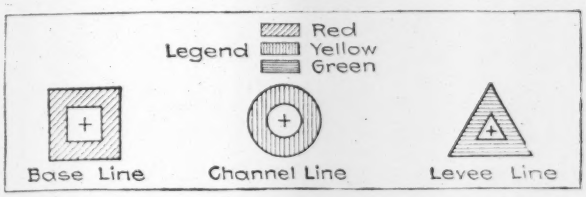
Urbana, Ill. W. M. WILSON,
Associate Professor of Structural Engineering,
University of Illinois.

HINTS FOR THE CONTRACTOR

Colored Figures Mark Transit Points

By H. A. Brentlinger
Dayton, Ohio

IN levee work in the Miami Conservancy District points along base, channel and levee lines were readily spoted by the use of colored figures. These were used only in concrete where crosses were hard to find or identify. Base line points were marked with a red



square; channel points enclosed in a yellow circle; and the levee line points marked with a green triangle. Stationing was indicated above all points and the offset of channel and levee points below.

Wooden Roller Used in Striking Concrete

By Searcy B. Slack
Montgomery, Ala.

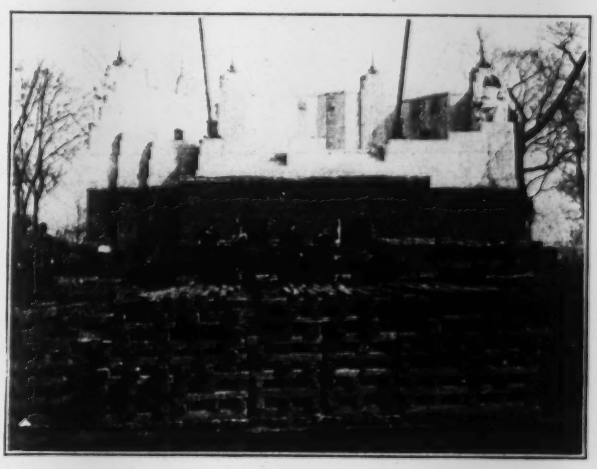
A WOODEN roller, turned from hardwood, is being used successfully for striking concrete pavement 9 ft. wide with a 1½-in. crown in Brooks County, Ga. The diameter of the roller at the ends is 9 in. and at the center 6 in. It was used first without protection, but the concrete so injured the surface of the wood that it was necessary to wrap the roller with a strip of galvanized iron 2 in. wide for its full length. The ends of the roller are provided with wheels having 1-in. flanges which run on the inside of the 2 x 6 in. form boards. Handles provided at each end allow the roller to be pushed forward in striking the material. Considerable difficulty in striking the concrete with a straight edge had been experienced previously, a condition the roller has largely remedied. The concrete pavement is being built of a crushed slag aggregate making the material difficult to finish. After striking the surface with the striking roller it is finished by means of a light wooden roller and hose in the usual manner.

This work is being done for Brooks County, Ga., by F. W. Long & Company, Jacksonville, Fla., Contractors, and is under the general supervision of Garrett & Slack, project engineers, for the State Highway Department of Georgia.

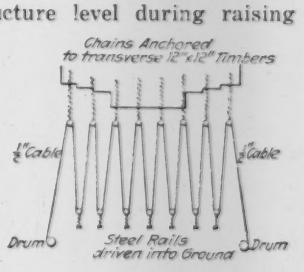
Marble Band Stand Successfully Moved

By George J. Trinkaus
Assistant Engineer, Lincoln Park Commission, Chicago

A MOVING operation, unusual in that the foundations were moved with the superstructure, has been completed at Lincoln Park, Chicago. The structure moved was a band stand, consisting of marble facing over a brick interior. Two groups of figures in marble by Lorado Taft are striking features and in all respects the structure was of such distinction that unusual care was warranted to prevent damage. Its moving was accomplished without checking or cracking the marble.



The weight to be moved was about 300 tons. The lateral dimensions are 44 x 27¾ ft. The foundations are reinforced concrete walls and pedestals. Both superstructure and foundations are shown by the view which also shows the cribbing on which the structure was moved. In preparation for moving, the foundation was first uncovered by excavating entirely around it, and the 4-in. concrete basement floor was then taken out, together with several thin partition walls in the basement. Screw jacks were then used to raise the stand to a height of 9 ft. above its original grade. Before raising, level marks were cut on all four sides of the foundation walls and at convenient corners to facilitate holding the structure level during raising and moving. The diagram illustrates the pulley arrangement. Two teams of horses furnished the motive power at the drums. The distance moved was 300 ft. and one right angle turn was made. The moving was done by Crowe Bros., moving con-

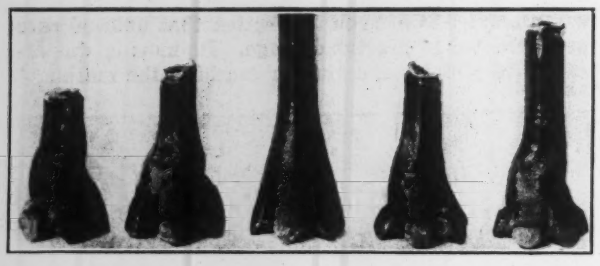


tractors, Chicago, under the supervision of John C. Canon, superintendent and secretary, and George T. Donoghue, chief civil engineer of the Commissioners of Lincoln Park.

Rock Drill Efficiency Requires Competent Blacksmithing

By D. E. Dunn
New York City

A POOR blacksmith is often at the bottom of a complaint that drills are poor. Even with the advent of the drill-sharpening machine, an incompetent or a careless blacksmith can make a useless tool from an excellent piece of drill steel. The illustration from actual practice demonstrates the possibilities. The four bits at the right and the left are typical examples of the output of a job blacksmith using a sharpening machine. They were the basis of a vigorous complaint by



EXAMPLES OF GOOD AND POOR DRILL SHARPENING

the owner that has jackhammer drills were failing to produce. Investigation by the representative of the drill manufacturer disclosed the kind of blacksmith's work which is illustrated. Using the same sharpening machine the manufacturer's representative produced from the same steel the bit shown in the center of the illustration. With this bit the jackhammers began again to produce. No drill sharpener, however good, can eliminate the necessity of a skilled blacksmith. This is a truth which users of rock drills cannot afford to forget.

Estimating Equipment Rental

YEARLY EXPENSE involved in owning equipment comprises three elements: 1, annual interest on original investment; 2, annual depreciation; and 3, insurance and storage during idle times. The annual interest rate represents the rate which, if applied annually against the original capital cost, will take care of interest charges throughout the useful life of the equipment at six per cent per annum on the average capital value. For example, if equipment costing $12,000 has a salvage value of $3,000, its average capital value during each year of its life is the mean between $12,000 and $3,000 or $7,500. Six per cent on $7,500 is $450. This is 3¾ per cent of $12,000, which is, therefore, the proper annual interest charge to be made against the original capital cost.

The annual depreciation rate is determined by dividing the original capital cost, minus salvage value, by the estimated length of life of the equipment, and then dividing this result by the original capital cost. Taking the same equipment mentioned above, and assuming its length of life to be six years,

$12,000 minus $3,000 equals $9,000

$9,000 divided by 6 equals $1,500.

$1,500 divided by $12,000 equals 12.5 the per cent which represents the annual depreciation rate to be charged against the original capital cost.

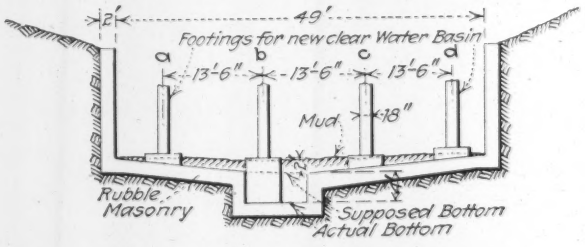
The rate to be charged for insurance and storage will vary with each organization, but once reduced to a percentage basis will be approximately the same for all equipment.

After the total annual percentage charge to be made against the original capital cost of any equipment is found, the same percentage may be used to find the expense chargeable to any other equipment which has the same length of life and whose salvage value is in proportion to the original cost, no matter what the actual original cost may be. The amount thus arrived at becomes a fixed annual charge against the equipment during each year of its life. A daily charge for owning equipment is estimated by dividing this fixed annual charge by the average number of earning days per year for each piece. To this amount, however, must also be added the average daily cost of general shop repairs or maintenance and the average daily cost of field repairs, before the full cost of the equipment on any job is secured.—*The A. G. C. Bulletin.*

Basin Footings Rest on Rubble Lining of Well

By James Riehl Arnold
Bucyrus, Ohio

AN EXTENSION to the waterworks at Bucyrus, Ohio, necessitated the carrying of a new clear water basin across an old well whose bottom was lined with rubble masonry of high bearing value. Soundings in the well gave the impression that its bottom was as indicated in the accompanying sketch, and the footings were, therefore, designed to rest on the old masonry at a 12-ft. depth. In the construction, a great amount of earth was thrown into the old well, and, in addition, heavy rains flooded part of the job, leaving 2 ft. of soft mud which had to be cleared out of the way of the concrete work. When the forms intended for the footing of column *b* were placed it was found that a 4-ft. sump occupied the middle of the old well, the bottom



of this sump being about 6 ft. below the surface of the mud. Foreman Glen Havens of the Rust Engineering Co. constructed a water-tight box of tongue and groove boards which was sunk in place by man weight and finally by driving with an 8 x 8-in. timber.

The inside of the box was baled out, and the concrete and steel were placed, bearing on the rubble at the bottom. The box was left in the ground. In the pouring of the column which rested on this footing, corrections for a slight, unavoidable eccentricity were made.

Chester & Fleming of Pittsburgh were the consulting engineers.

NEWS OF THE WEEK

New York, June 3, 1920

N. Y. Municipal Engineers Endorse Council's Salary Classification

Engineering Council's classification of salaries and grades for engineering service was endorsed by the Municipal Engineers of the City of New York at a meeting held in the Engineering Societies' Building, May 26 and devoted exclusively to a discussion of compensation. The approved schedule of minimum and maximum salaries follows:

Grade	Salary Range Min.	Max.
8—Junior Aid	$1,380	$1,920
7—Aid	1,980	2,920
6—Senior Aid	3,000	3,840
5—Junior Ass't Engineer	1,980	2,940
4—Assistant Engineer	3,120	5,040
3—Senior Ass't Engineer	5,220	7,080
2—Engineer	7,200	No limit
1—Chief Engineer	10,000	No limit

Action by the society followed the submission to its Board of Directors of a report on classification and compensation by a committee consisting of Philip P. Farley, chairman, Amos Schaeffer, Robert Ridgway, Chandler Withington, W. W. Brush, Arthur W. Tidd, H. K. Endemann, Elmore F. Austin, Samuel Hamburger, Victor H. Reichelt, and Charles E. Conover. The board, however, objected to the term "sub-professional," employed by Engineering Council's committee in explaining its classification, on the ground that it was distasteful to the men in the lower ranks of the service. The society, while approving in full Engineering Council's classification, concurred in the findings of its Board of Directors and endorsed the suggestion that Engineering Council be urged to consider the desirability of substituting the terms "engineering" and "engineering aid" for Council's designations "professional" and "sub-professional" as descriptive of character of duties performed.

Discuss Engineer Qualifications

In defending Engineering Council's nomenclature Arthur S. Tuttle, deputy chief engineer of the New York Board of Estimate and Apportionment, and chairman of Council's Committee on Classification and Compensation of Engineers in Municipal Service, contended that the larger aspects of the problem, particularly as they involve a proper recognition by the pubilc of the qualifications of an engineer, demand a clear distinction between types of service which demand broad experience, judgment and technical skill, and those that do not. Any failure to recognize this distinction, he pointed out, would tend toward a lowering of professional standards and would, in the end, work to the disadvantage of all engineers. In this view Robert Ridgway, engineer of subway construction, Transit Construc-

(*Continued on p. 1128*)

Hoover To Become Member of A. A. E.

Herbert Hoover, chairman of the American Relief Commission and president of the American Institute of Mining and Metallurgical Engineers, has applied for membership in the American Association of Engineers. The membership number assigned to Mr. Hoover is 20,000. General Leonard Wood, who is also a member, has membership number 10,000. The association has not declared itself in favor of either General Wood or Mr. Hoover as possibilities for the presidency.

Illinois Central Defers Improvements

Work on the new Chicago terminal station, electrification and lake front improvement is not likely to be undertaken this season by the Illinois Central R.R., owing to the financial situation and other uncertain conditions. It is proposed to build a subway at Randolph St., however, to enable pedestrians to pass under Michigan Ave. and avoid the delay and inconvenience of crossing the dense automobile traffic on the avenue.

Hudson Vehicle Tunnel Contract Authorized

Preparation of plans, specifications and contract forms for the construction of the four permanent ventilating shafts of the Hudson River vehicular tunnels was authorized May 25 by the state bridge and tunnel commissions of New York and New Jersey. Chief Engineer Clifford M. Holland and his engineering staff are now at work on the details of the shaft portions of the project and it is expected that a call for bids will be made by Sept. 1.

The Governor of New York on May 24 signed the bill making available another $1,000,000 for the subaqueous interstate vehicular route. New York's first $1,000,000, of which about $100,000 has been spent, was appropriated last year. Last year New Jersey provided $1,000,000 for the work and this year the state legislature passed over the Governor's veto a bond issue bill for $28,000,000, half of which is to be devoted to tunnel construction and half to the proposed Camden-Philadelphia bridge. This $28,000,000 bond issue will be referred for referendum vote of the New Jersey electors in November.

The question of widths of roadway in the tunnels, about which there has been a great deal of discussion, has been settled by the joint commissions in adopting the 20-ft. roadways originally recommended by Mr. Holland. The proposed use of concrete blocks for the tunnel construction has been definitely rejected.

Federal Water-Power Bill Passes Both Houses

Measure Sought For Past Twelve Years Now Before President For Approval

(*Washington Correspondence*)

Threats to filibuster against the conference report on the water-power bill in the Senate simmered down to perfunctory opposition when the conference report actually came before the Senate. It was approved May 28 by a vote of 45 to 21. While there was objection on the ground that the measure did not properly protect the interests of the public, the real opposition came from the fear that the powers granted by the bill interfered too greatly with rights which heretofore have been regarded as belonging to the states. The licensing feature was unpopular in that it would require those interested in the use of water "to come, hat in hand, to Washington" to make the necessary arrangements.

The bill provides for a Federal Power Commission which is to be composed of the Secretaries of War, Interior and Agriculture. The commission is empowered to appoint an executive secretary. It is recognized that this officer will be in practically absolute control of the administration of the law. In addition, the commission "may request the President to detail an officer of the Engineer Corps to serve as engineer officer."

Commission With 45 Functions

The bill prescribes forty-five specific functions, or duties, for the commission. These duties fall under the following heads:

General administration of water powers; design, construction and operation of project works; regulation of financial operation; regulation of rates and service; valuation of properties of licensees; general investigations; specific investigations.

Under these heads a few of the more important duties which are specifically designated are: To issue licenses for power projects and transmission lines on navigable waters, public lands and reservations of the United States; to hold hearings in connection with application for permits or licenses; to approve maps, plans and specifications of project works; to require that project works be properly maintained and kept in efficient operating condition; to regulate under certain conditions the amount and character of securities which may be issued for the financing of power projects; to make valuations of properties for the purpose of rate making and to determine what is the net investment in the property; to report on the utilization of water resources of any region to be developed;

to report on the water power industry and its relation to other industries; to make examinations and surveys and report in connection with any project which the Commission believes should be undertaken by the Unitede States; and to report on the Great Falls water-power project near Washington.

The bill having passed both houses, is now before the President for approval.

Possibly No Rivers and Harbors Bill

It is reported from Washington that there may be no Rivers and Harbors Bill this year because of the inability of the House and Senate conferees to come to an agreement. The House bill carries only $12,000,000 while the Senate provides $24,000,000.

Canadian Water-Works Men Invited

A special invitation to attend the Montreal convention of the American Water Works Association, June 22 to 24, has been sent out to Canadian water-works men by J. M. Diven, secretary, 153 W. 71st St., New York City. If any Canadians have been missed Mr. Diven would be glad to send them a program.

Building Industries Ask Recognition in Car Service

Following the petition of the carriers to the Interstate Commerce Commission to invoke its executive powers to relieve the nation-wide freight congestion, the National Federation of Construction Industries has addressed a request to the commission asking that recognition be given the various branches of the construction industry in such orders for car service as might be issued by the commission. The closing paragraphs of the builders' petition follow:

The railroads are dependent upon the construction industry for the meterial wherewith to maintain their roadbeds. Highways, bridges, agricultural, industrial and other structures are products of this industry. Approximately fifty per cent. of the cement produced in this country, and large quantities of hollow tile, brick, lumber, lime, crushed stone, sand and gravel and other materials supplied by the industry are consumed by the farmers of the United States, mainly in the improvement and enlargement of their productive units.

The attention of the Commission is respectfully called to the fact that the uses to which construction materials are usually put are essential to the walfare of the general public; and that the degree of essentiality of any material in an emergency such as is now reported to exist should be determined by the consideration of the purpose to which it is put.

WHEREFORE, having called the earnest attention of the Commission to the essential character of the construction industry, and having set forth all the matters hereinbefore mentioned, and now assuring the Commission of its willingness to furnish to the Commission upon request any additional facts which it may have in its possession or may be able to obtain, your petitioner prays that in the effective exercise of the powers and duties cast upon the Commission by law in emergencies such as are reported now to exist, the Commission will recognize the essential character of the service being rendered by the construction industry and save the same harmless in this emergency.

Minnesota Engineering Board Endorses Shenehon for Joint Commission

The Minnesota Joint Engineering Board has passed resolutions, urging the appointment of Francis C. Shenehon, consulting engineer, of Minneapolis and formerly Dean of the College of Engineering, University of Minnesota, to the vacancy in the membership of the International Joint Commission. The action of the Board is based on the following statement of conditions:

1. The death of Governor Glenn has created a vacancy in the membership of the American Section of the International Joint Commission (as noted in *Engineering News-Record* last week, p. 1079).

2. As the work of the commission deals primarily with expert hydraulic investigations and judicial findings relating to the boundary waters between the United States and Canada, stretching from the Lake of the Woods and the international streams of the Minnesota frontier, through the Great Lakes and the St. Lawrence River to St. Regis, the deliberations of the commission will be clarified and the reaching of conclusions facilitated by including in its personnel an engineer of national and international reputation, whose life work has familiarized him with the physical and economic phases of these great waterways.

3. The Canadian section of the Commission already has the advantage of an engineer in its membership.

4. The two existing members of the American section are from Maine and Wyoming. The propriety of the selection of the third member from Minnesota, one of the states contiguous to the Great Lakes and greatly interested, is obvious.

5. The comprehensive and exhaustive investigation of the feasibility and desirability of a deep-draft waterway between the Great Lakes and the Ocean, recently imposed by Congress on this Commission, involving technical questions of wide reach in navigational and water power development, accent in a way not before accented, the need on the Commission of an Engineer expert in these subjects.

Mr. Shenehon has had a great variety of experience in connection with the Great Lakes. From 1891 to 1898, he was engineer of ship locks, canals, docks, power house and river improvements, St. Marys River, Michigan; from 1898 to 1902 he conducted hydraulic investigations on the Niagara and St. Lawrence Rivers; and up to the present time he has continued in consulting business in connection with the Great Lakes. The report on control of Lake Erie, published in *Engineering News-Record*, of Feb. 12, 1920, shows Mr. Shenehon's familiarity with the general subject.

He was Dean of the College of Engineering of the University of Minnesota from 1909 to 1917.

Engineer Board Named To Form National Highway Policy

The Advisory Highway Board which has been appointed by the Secretary of Agriculture will hold its first meeting in Washington June 4 and 5. At that meeting the Board expects to decide upon the basic principles which should be followed in working out a national highway policy. The personnel of the committee is as follows: Paul D. Sargent, chief engineer, State Highway Commission, Augusta, Maine; Joseph Hyde Pratt, secretary, American Association of State Highway Officials, Chapel Hill, N. C.; George E. Johnson, state engineer, Department of Public Works, Lincoln, Nebraska; W. G. Thompson, state highway engineer, Trenton, N. J.; Ira R. Browning, state road engineer, Salt Lake City, Utah; W. D. Uhler, chief engineer, State Highway Commission, Harrisburg, Pa.; C. J. Bennett, state highway commissioner, Hartford, Conn.; A. B. Fletcher, state highway engineer, Sacramento, Cal.; W. R. Neel, state highway engineer, Atlanta, Ga.; W. S. Keller, state highway engineer, Montgomery, Ala.; Geo. P. Coleman, state highway commissioner, Richmond, Va.; S. E. Bradt, superintendent of highways, Springfield, Ill.

New York State Control of Barge Canal Deferred

Senator Wadsworth's joint resolution to Congress requiring the Federal Government to return all control of the New York State Barge Canal to the State of New York has passed the Senate, and is now before the House. It is stated that there is no immediate prospect of its passage in that body.

Salary Schedule Endorsed

(*Continued from p. 1127*)

tion Commission, concurred. William W. Brush, deputy chief engineer, Department of Water Supply, Gas and Electricity, favored the use of the terms "engineering" and "engineering aid" as being more truly descriptive of the kind of work performed and, at the same time, as offering no grounds for complaint on the part of men classified in the lower group. From the discussion by other members of the society it was clear that there was a rather general objection to the term "sub-professional." When put to a vote the proposal to suggest to Engineering Council the substitution of the terms already indicated was passed, although this action does not affect in any way the complete endorsement of Council's schedule of salaries and grades by the Municipal Engineers of the City of New York.

The point was made by several speakers that it is time for engineers to stop quibbling over mere details of terminology and to get together in a country-wide movement supporting the new schedules of compensation which have been recommended.

No New York Water Power Law This Year

Having failed throughout the past session to come to any agreement on a state water-power policy, the New York State Legislature in its last days passed an innocuous looking act ostensibly intended only to protect the State of New York in the event of the Federal Water Power Bill being enacted before New York could pass a bill protecting its own rights in state water-power. The bill provided that no water could be diverted from Lake Erie, the Niagara River, or the boundary waters of the State, or used in developing hydro-electric power until a written instrument had been filed with the Secretary of State under which the individuals or companies diverting the water assented to the right and power of the State to exact a reasonable rental for the water and consented to the right and power of the State to fix a reasonable rate for the hydro-electric energy developed.

It was the intent of the promoters of the bill to prevent the State losing its water-power rights to the Federal Government by reason of the fact that there were no laws on the statute books providing for the assertion by the State of its rights in these powers. It did not commit the State to either the government ownership or government development plan of water-power control.

The bill, however, did not appeal to Governor Smith of New York who vetoed it on May 18. The Governor said that the bill, if it became law, would "so vitalize some practically defunct corporations as to permit them to exercise the right to take water for hydraulic or hydro-electric power purposes, where they now have only the right to take it for entirely different purposes." The Governor at the same time came out strongly in favor of the public development of the water-power in the State.

Winnipeg Entertains Seventh Good Roads Congress

Highway engineers from the United States as well as from all parts of Canada were among the speakers who were listed on the program of the seventh annual good roads congress held in Winnipeg June 1-3. Among them were E. O. Hathaway, district engineer, Bureau of Public Roads; Professor Arthur H. Blanchard; A. P. Sandles, National Crushed Stone Association; A. R. Hirst, state highway engineer, Wisconsin; Col. W. D. Sohier, former chairman Massachusetts Highway Commission; W. H. Connell, consulting engineer, Philadelphia. Besides the reading of numerous papers on highway construction, maintenance and administration, there were several demonstrations of actual road building, and of road grading and dragging. The congress was presided over by S. L. Squire, president of the Canadian Good Roads Association.

Year's Trial Proves Value of Co-operative Plan at M. I. T.

For the past year an experiment in co-operative engineering education has been conducted by the Massachusetts Institute of Technology and the General Electric Co. While the co-operative scheme in itself is not new, several departures from the usual plan were introduced.

The class was limited to 30 students, chosen entirely upon the records which they had made in the equivalent of the first two years' work of the electrical engineering course at Technology. Included in this group were graduates from Yale, Harvard, Dartmouth, Princeton, the Naval Academy, besides men who had completed their first and second years solely at Technology. The year (12 months) is divided into four three-month periods, the students spending alternately 13 weeks at the Lynn works of the General Electric Co. and 11 weeks at the Institute, followed by a two weeks' vacation. The group at Lynn is housed in a fine old residence which has been converted into a modern club house. No break is made in the major studies when the students are at Lynn, courses being conducted at the works in principles of electrical engineering and in general studies. The progress of the students through the plant is regulated, not by the production needs of the various departments, but by the advantage which the experience in each department is to the student.

The result of this year's work has been gratifying to the originators of the plan. Because the students were a selected group, were all taking the same course, and were thrown together intimately at work and at the club house, a spirit of loyalty to one another, to the Institute and to the General Electric Co., soon became manifest and every man strove to make a reputation for the course. Their enthusiasm was soon shared by the officials and superintendents of the co-operating company.

As evidence of its approval of the work, the company has increased the number of men who can be enrolled in this year's class to 60 and has already secured a new club house in order to furnish rooming accommodations for them. The new class which has already nearly completed its quota of members will enter upon the work July 6.

Carpenters Strike in McKeesport

Contractors in McKeesport have learned that it is dangerous to delay, and as a result of their hesitancy building construction is at a standstill due to a strike of the carpenters. The carpenters, who have been receiving 87 cents an hour, demanded $1.12½, and the contractors had all but signed the new agreement when they decided to attempt a compromise at $1 per hour. This compromise offer was met by the carpenters with a new demand for $1.25 per hour, and as they now refuse to compromise a strike is in progress.

Engineers Question Candidates for Public Office

The Charleston (W. Va.) Chapter of the American Association of Engineers has adopted a resolution requesting all candidates for public office in West Virginia to answer the following six questions:

(1) Are you in favor of the enactment of a law for the licensing of professional engineers, architects and land surveyors?

(2) Are you in favor of giving greater powers to the state board of health, and enacting legislation to remove the present conflict in authority between the state board and local boards?

(3) Do you favor providing the state board of health with increased funds to carry out necessary work, such as is now done by all progressive states?

(4) Are you in favor of the state acquiring land and taking the lead in reforestation, thus stimulating private interests in the work of reclaiming denuded areas and adding to the wealth and resources of the state?

(5) Do you favor submitting to the voters a constitutional amendment permitting cities to issue bonds to at least ten per cent of their assessed valuation, for the purpose of acquiring and operating such self-supporting and income-bearing properties as water works, electrical plants and market places?

(6) Are you in favor of amending the constitution for the issuance by the state of $50,000,000 bonds for good roads?"

The chapter has requested the assistance of other engineering and architectural organizations in giving prominence to these questions as a means of developing a public appreciation of the necessity for engineering talent in state administration.

Research Council Elects Officers

The National Research Council has elected the following officers for the year beginning July 1, 1920: Chairman, H. A. Bumstead, professor of physics and director of the Sloane physical laboratory, Yale University; first vice-chairman, C. D. Walcott, president of the National Academy of Sciences and secretary of the Smithsonian Institution; second vice-chairman, Gano Dunn, president of the J. G. White Engineering Corporation, New York; third vice-chairman, R. A. Millikan, professor of physics, University of Chicago; permanent secretary, Vernon Kellogg, professor of entomology, Stanford University; treasurer, F. L. Ransome, treasurer of the National Academy of Sciences. Not all of the chairmen of the various divisions of the council have been selected but will be announced later.

Industrial Course at Penn. State

A two weeks' summer course in industrial organization and management is being offered for the fifth consecutive year by the Pennsylvania State College from Aug. 9 to 21. It is designed to meet the needs of manufacturers, superintendents, employment directors, foremen, accountants and all others who pilot the daily affairs of industry and who are willing to devote two weeks to intensive study. Its purpose is to assist men in the development of their jobs and to illustrate to them by practical examples the most effective methods of modern organizations.

Building Trades Attempt to Make St. Louis Closed Shop City

The Building Trades Council of St. Louis officially served written notice upon all architects, general contractors, associations of general contractors, master builders, and others engaged in building operations that on and after Sept. 1, 1920, no work will be begun or undertaken on any building operations in the territorial jurisdiction of the council, unless the names of all contractors and sub-contractors bidding on any certain work or for the installation of equipment shall be submitted to the council for examination and approval. The council also demands that contracts for building and equipping every structure in its entirety be let simultaneously.

The council will furnish the architect or contractor with a printed list of the various parts of the work to be done on buildings. This list is to be filled out with the names of the shops or firms to whom the work has been awarded, and then posted in the tool shed or office on the job before work is begun so that representatives of the trades may see it.

The resolution is given herewith:

Whereas, There has been a common practice prevalent among owners of buildings to reserve some of their contracts for work to be done on their buildings, which practice has resulted in much dissatisfaction, and in many instances in delays in completing the operations on such buildings or jobs on account of some of the contracts or sub-contracts being let out to persons or firms not employing union labor, and thus causing much complaint on the part of the trades affiliated with this council, and much criticism by the owners and by the general contractors that employ union labor, and much apathy on the part of the financial interests that promote building operations, and

Whereas, The Building Trades Council of St. Louis, Mo., has repeatedly declared itself to be in favor of a plan of letting all contracts and sub-contracts for the building and equipping of all structures at one and the same time so as to eliminate the possibility of some of the work being let to firms that do not employ union labor, therefore be it

Resolved, That this Building Trades Council in regular meeting assembled on this, the 21st day of April, 1920 does hereby re-affirm its position in regard to letting contracts for the entire structure at one and the same time, and be it further

Resolved, That the secretary of this council be authorized to serve a written notice bearing the official seal of this council to all architects, general contractors, associations of general contractors, master builders and others engaged in building operations to the effect that on and after Sept. 1, 1920, no work will be begun or undertaken on any buildings in the territorial jurisdiction of this council, unless the names of all contractors and sub-contractors bidding on all of the work to be done on the said buildings in their entirety, and for the installation of all equipment shall be submitted to this council for their examination and approval, and be it further

Resolved, That all trades affiliated with this council shall submit to the secretary of this council a written or printed list of all the shops or persons employing their members in compliance with their trade rules, and that any corrections to said list be immediately submitted in writing to the secretary, so that all names of fair shops may be accessible for comparison with the names of contractors and sub-contractors contained in the lists of bidders sent to this council by the architects or owners.

Col. Cooper Appointed Consulting Engineer at Muscle Shoals

Hugh L. Cooper & Co., of New York City, have been appointed consulting engineers on the new hydro-electric plant and dam now under construction by the Government at Muscle Shoals on the Tennessee River. The appointment comes from Major General Beach, Chief of Engineers, U. S. A., who is in charge of the work. Colonel Cooper made a report on the dam construction at Muscle Shoals about two years ago, when he was in the Army, but returned to France before any of his recommendations were carried out.

Lincoln Highway Association to Build "Ideal Section"

What it terms an "ideal section" is to be constructed some time this summer on the route of the Lincoln Highway by the Lincoln Highway Associations. To secure such a section, a board of engineers will be appointed by the association to pass upon plans submitted in reply to a questionnaire that has gone broadcast throughout the United States. The association has sought the advice and opinion of highway commissioners and highway engineers, and from the mass of correspondence in reply, the board of engineers will be asked to select specifications covering the construction of an ideal section. That there will be a wide divergence of opinion among American engineers in determining what specifications should cover the construction of an ideal section is a matter appreciated by the association.

Tentative plans for the construction of this section combine not only considerations of permanency, traffic volume, safety and convenience, but of beautification and of accommodation. It is well understood by the association that the exact location of any section of highway is largely determined by the question of cost, type of drainage provided, thickness of surface desirable, width of paving, etc. The ideal section will therefore be placed upon average subsoil in the open country.

Conditions in Russia Discussed at Joint Meeting

Under the auspices of the Joint Committee of Russian and American engineers of Engineering Council a largely attended meeting on Russia and the possibilities of a *liaison* between the engineering societies of Russia and of America was held in the Engineering Societies' Building, New York, May 26. W. N. Polakov presided. In the introductory address, N. A. Stephanoff sketched the development of the engineering profession in Russia and pointed out the special qualifications, due to conditions and national psychology, by virtue of which Russian engineers are well adapted to co-operate with American engineers; their excellence in engineering theory and their conscientiousness in detail development were particularly emphasized. In 1910, it was stated, there were 45,000 engineering students in Russia attending polytechnic or special colleges; in addition to these, there was a large class of "practical" engineers. Since the beginning of the war, however, the number of engineers in Russia has been greatly decreased through emigration.

W. F. Dickson, for many years manager of the Russian Singer Co., then outlined some of the achievements of Russian engineers, in bridge engineering, in railway construction, and electrical, steam and aerial engineering. He recalled how, in spite of the relatively backward national development, much work of leadership and new creation had been accomplished by engineers of Russia.

The principal feature of the evening was in illustrated lecture on "Resources of Russia," by Dr. J. M. Goldstein, professor of economics in Moscow University. By means of a great number of lantern slide diagrams, Professor Goldstein showed the very low state of development of Russia's natural resources. Not only are these resources still largely unexplored and unknown, but the agricultural and mineral production per capita, and particularly the amount of power used in manufacturing per capita of the population, are only small fractions of the corresponding amounts shown for other countries. In agricultural exports, Russia has therefore been far outstripped in the last decade or more by such countries as Argentina. Export of oil has decreased not only relatively to that of other countries but also in absolute amount.

Road Condition Bulletins To Be Issued by Massachusetts

Announcement is made by John C. Cole, Commissioner, Department of Public Works of Massachusetts, that highway bulletins will be issued for the purpose of informing truckmen and motorists of the condition of the state roads. The location of detours, the condition of roads under construction as well as the condition of the roads constructed will be posted weekly.

City Board Overrules Objections to $1,000,000 Sewer

Bids for the construction of a trunk line sewer system for the city of Anderson, Ind., were received May 24 by the city's board of public works, in spite of a remonstrance against the improvement made May 12 and carrying the names of more than 2,000 citizens. The improvement will cost nearly $1,000,000.

Let $1,000,000 Sewer Contract

The Green & Sons Construction Company, of Chicago, offered the only bid presented for the construction of the new trunk line sewer at Anderson, Ind., and received the contract for $919,692.40. The bid was the same as the one offered by the company last March when the contract was awarded and soon afterward rescinded because of irregularities in the proceedings.

Committee of Management Named for Grand Trunk

Announcement has been made of the appointment of the Committee of Management for the co-ordination of the Grand Trunk Ry. with the Canadian National system. The committee will consist of: Chairman, Howard G. Kelly, previously president, Grand Trunk Ry.; C. A. Hayes, vice-president, Canadian National Rys.; S. J. Hungerford, assistant to vice-president, Canadian National Rys.; Frank Scott, vice-president and treasurer, Grand Trunk Ry., and W. D. Robb, vice-president, Grand Trunk Ry., who is in charge of transportation, construction, and maintenance of way of the Grand Trunk Ry.

Indianapolis Approves $2,000,000 Flood Protection Work

Under orders issued by the Indianapolis board of public works May 26, the city engineering department will begin plans for the completion of the flood prevention work on the east side of White River between the New York Central railroad bridge, south of Washington street, to Raymond street. F. C. Lingenfelter, city engineer, estimated that the cost of the work would be about $2,000,000. A channel line will be established on the east side of the river providing for a channel of 650 ft. in width, in conformity to the floor prevention work already constructed on the west side of the river.

Two bends in the river, one at the Belt railroad and the other between Morris street and Oliver avenue, will be eliminated and the river will have a straight sweep. Mr. Lingenfelter recommended that the work be started as soon as possible, as a repetition of the 1913 flood would greatly endanger the Oliver Ave., Kentucky Ave. and Morris street bridges. He pointed out that the completion of this work at the present time was more important than to take up the flood prevention work farther north, as the widening of the channel at this point would relieve the territory to the north in case of a flood and would protect the three important bridges.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Sept. 13-17.

ORGANIZING CONFERENCE of National, State and Local engineering societies; Washington, D. C., June 3-4.

The Albany (N. Y.) Society of Civil Engineers was addressed May 25 by Albert H. Perkins, chief of the Division of Waters, New York State Conservation Commission, who spoke on "Water Power Economics and Politics."

The Utah Society of Engineers elected the following officers at the recent annual meeting: President, H. T. Plumb; vice-presidents, Leroy M. Pharis and E. H. Beckstrand; secretary, W. E. Turner, and treasurer, R. K. Brown.

The Boston Society of Civil Engineers and the New England Water Works Association will hold a field day June 9 at Wardhurst, Lake Suntaug, Lynnfield, Mass. A train with special car is scheduled to leave North Station, Boston & Maine R.R. at 9:04 Eastern Standard time.

PERSONAL NOTES

LIEUTENANT-COLONEL ARTHUR PARKER, Q. M. C., recently discharged from the Army, has been appointed city engineer of Cheyenne, Wyo., succeeding E. W. Glafke, who has removed to California.

CAPTAIN O. G. BAXTER has resigned as senior drainage engineer, U. S. Bureau of Public Roads, and has established the Baxter Engineering Co., with offices in the Moore & Turner Building, Little Rock, Ark. The Baxter Co. will specialize in drainage and is prepared to give expert advice and reports upon organization, design and construction of drainage and flood protection projects.

WARREN E. DARROW, who served as captain of Engineers, U. S. A., during the war, and who has been commissioner of public works of Utica, N. Y., for the past five months, has resigned from that position on account of poor health. DANIEL T. BUTTERFIELD has been appointed to the office.

CHARLES GREENWOOD, engineer of Lewis County, at Chehalis, Wash., has resigned to engage in the logging business. ROY L. GREEN, of Centralia, has been appointed to succeed him.

L. E. STRAHM has been appointed city engineer of Kent, Wash.

HENRY M. WEITZNER, formerly of the Nitzberg & Weitzner Co., Inc., has opened offices in New York City, under the name of Engineering Construction Co., and is prepared to execute all kinds of engineering and general contracting work.

J. E. PIERSON has been appointed engineer of District 2, Wyoming State Highway, comprising the Counties of Carbon, Sweetwater, Unita and Lincoln, with headquarters at Rock Springs, Wyo. He succeeds R. V. Newcomb, resigned.

CAPTAIN A. E. STONE, until recently with the Construction Division of the Army, at Washington, D. C., has resigned to accept a position with Thomas Palmer, general contractor, Scranton, Pa. He will have supervision of construction work.

HORACE E. SMITH, engineer of Okanogan County, Wash., has resigned to enter private business in Okanogan.

LIEUTENANT R. J. OSBORNE has been discharged from the Construction Division of the Army and has taken a position in the engineering department of the St. Regis Paper Co., at Deferiet, N. Y.

DAVID J. HOWELL, senior member of the firm of David J. Howell & Son, civil engineers, Washington, D. C., has been appointed chief engineer of the Arlington Sanitary District, by the Board of Supervisors of Alexandria County, Va., which acts as the sanitary commission for that district. A bill was recently passed creating a sanitary district of Alexandria County and providing for water and sewerage districts to be known as the Arlington Sanitary District. The three members of the board of supervisors are designated as the sanitary commission and are empowered to divide the county into sub-districts upon application of a certain number of qualified voters in one or more of said districts.

A. D. SCOTT, construction engineer, of Watertown, N. Y., who has lately been with the Hydraulic Construction Co., that city, has become associated with James P. Brownell, consulting engineer, of Carthage, N. Y., as construction engineer for Mr. Brownell on the erection of a new power house for the Northern New York Utilities, Inc., at Black River, N. Y.

FRANK S. ROBERTSON, who for the last six months has served the district as chief engineer, has been made general manager of the Cameron County Water Improvement District No. 2, with headquarters at San Benito, Tex. He succeeds P. R. Foley, who tendered his resignation as a member and presi-

dent of the board. I. N. Penrod, a director, was elected to fill the vacancy.

W. H. DEAN, assistant engineer in charge of the Twelfth St. bridge, city engineer's office, Chicago, has been appointed manager of the Chicago chapter, American Association of Engineers, to fill the vacancy caused by the resignation of E. J. Burke, who has entered the firm of York, Regan & Burke, as previously reported in these columns.

DR. LOUDER W. JONES, dean of the Colleges of Engineering and Chemistry, University of Minnesota, has resigned to accept a professorship at Princeton University, his resignation to become effective July 1. During the war he was director of research in the Chemical Warfare Department at Washington.

E. M. EVANS, recently city engineer of Herkimer, N. Y., has been appointed city engineer of Norwich, N. Y., to succeed Robert C. Wait. Mr. Evans was formerly general superintendent of construction in the Department of Public Works and Roads, Province of Quebec, in the engineering department of the New York Central and the Delaware & Hudson roads and with the New York State highway and canal departments. Previous to his employment at Herkimer, he served as city engineer at Oil City and Franklin, Pa.

O. E. CARR, for the past two years city manager of Springfield, Ohio, has resigned to accept the city managership of Dubuque, Iowa, at a salary of $700 a month. Mr. Carr installed the city-manager form of government at Cadillac, Mich., in 1914, and the commission-manager form at Niagara Falls, N. Y., in 1916.

LOUIS A. WILSON, recently with the Iowa Highway Commission, is now with the Holt Manufacturing Co., Peoria, Ill., in sales research work on construction and road building.

CLAUD A. RENSHAW, civil engineer, Roundup, Mont., has been elected mayor of that city.

C. E. SOUTHWORTH, for the past three years project engineer at Fort Hall, near Pocatello, Idaho, resigned recently to engage in a private business enterprise at Tonopah, Nev.

H. S. BAKER, chief deputy of Spokane County, road construction engineer, has been appointed engineer of Spokane County, Wash., to fill the vacancy caused by the resignation of Allan R. Scott, who is entering private business. Mr. Baker will have charge of maintenance on the county roads.

FRANK WALLACE, recently connected with the county engineer's office at Colfax, Wash., is now resident engineer at Missoula, Mont., for the U. S. Bureau of Public Roads.

E. L. ALSPAUGH, formerly with the Oregon State Highway Commission; Fred Cotter, formerly of the Portland, Ore., office, and L. F. Martin, have received the appointment of chief of party with the U. S. Bureau of Public Roads, and will be located in the Missoula, Mont., office.

OBITUARY

TIMOTHY FOLEY, widely known railroad contractor, died at his home in St. Paul, Minn., May 25. He had been in ill health since last fall, the cause of his death being pernicious anemia. Mr. Foley was born Aug. 20, 1838, in Lanark County, Ontario, Canada. He came to Minnesota in 1879, accompanied by his brother, Michael Foley, now the only surviving member of the firm of four brothers, known as Foley Brothers. His firm was largely interested in the building of virtually all the railway lines of the Northwest, including the Great Northern, Northern Pacific, Soo Line, St. Paul, Burlington and Northwestern in the United States, and the Canadian Pacific, Canadian Northern and the National Transcontinental in Canada. At one time Mr. Foley was president of the Duluth & Winnipeg Railway, now a part of the Great Northern System. His company recently finished the construction of the ocean terminals at Halifax, Nova Scotia. Besides his activities in railroad construction, Mr. Foley was one of the pioneer lumbermen of Minnesota, and was the active head of many lines of business enterprises in the Northwest. During recent years he gave extensively to charities and assisted numerous educational institutions. Mr. Foley was a life-long friend of the late James J. Hill, with whom he worked in the building of the empire of the great Northwest.

CHRISTOPHER KUPPLER, founder of the contracting firm of Chris. Kuppler & Sons, of Seattle and Port Angeles, died recently in Seattle at the age of 60. For the past 32 years, Mr. Kuppler has been engaged in contracting work in the Puget Sound district, particularly in the Puget Sound Navy Yard and Port Angeles.

JOHN B. FRAIM, recently in charge of construction work at the Sparrow's Point (Md.) plant of the Bethlehem Steel Co., died May 9, at Biglerville, Pa. Mr. Fraim was engaged in structural steel and bridge building work for 45 years, during which time he built bridges in nearly every part of the United States and in Canada. For a number of years he was superintendent of erection for the Pennsylvania Steel Co.

JAMES W. JOHNSTON, contractor, died recently at Utica, N. Y. He was born in Belfast, Ireland, in 1840, and when he came to this country settled near Utica. After serving through the Civil War, he engaged in various enterprises until 1890, when he became associated with the contracting firm of T. J. Dyer & Co., and engaged in canal construction. In later years he was in charge of a large amount of road, sewerage and grading work in the vicinity of Utica.

BION BRADBURY, formerly commissioner of public works of Portland, Me., and during the war plant engineer for the Cumberland Shipbuilding Co., died at Cape Elizabeth, Me., May 16. In his early years of engineering activities he served for seven years on the U. S. Coast and Geodetic Survey on the Eastern coast, Lake Champlain, Florida, Mississippi River and Narragansett Bay. He later associated himself with Edward C. Jordan, of Portland, doing location work for the Rumford Falls, Rangeley Lakes, and Franklin & Megantic narrow-gage railroads in Franklin County. When Mr. Jordan became city engineer, Mr. Bradbury was appointed his first assistant, in which capacity he did a large amount of the survey and topographical map work on outlying sections of Portland and the Islands of Peaks, Long and Cliff. In 1907, he was appointed commissioner of public works and re-appointed in 1910, finishing his term in 1913, at which time he resumed private practice until the outbreak of the war. Mr. Bradbury was a member of the Maine Society of Civil Engineers. He was also appointed by Governor Milliken a member of the Maine Water Power Commission.

JAMES M. EDWARDS, civil engineer and railroad operator, died in New York City, May 24, at the age of seventy. Mr. Edwards was born in Oglethorpe County, Georgia. He was graduated from the University of Georgia in 1869 as a civil engineer. Between 1881 and 1884 he was engaged in building the Louisville, New Orleans and Texas Railroad, now the Yazoo & Mississippi Valley. He was in charge of operations as vice-president and general manager until 1894. Later he was connected with the Illinois Central. In 1890 he moved to New York City and, associated with the R. T. Wilson Co., he became interested in street lines and had charge of the construction of the Yonkers street railroad, of which he was president, and the Nashua electric line in Brooklyn. In 1902, in conjunction with Tom L. Johnson, Mr. Edwards reorganized and consolidated the street railroads in Detroit into the present Detroit United Railways of which for a time he was president. When the Wilson firm turned its attention to the chemical industry, Mr. Edwards became head of Matheison Alkali Works of Saltville, Va., and of its subsidiary, the Castner-Eltro Alkali Co. of Niagara Falls, continuing as president of this company until after the death of Mr. Wilson. He retired from business in 1917.

SUTHERLAND HUTTON, civil engineer, Santa Monica, Cal., died in that city May 14. He was one of the founders of Santa Monica and at one time was park commissioner.

ROBERT STONE, fifty-five years old, a civil engineer of Muncie, Ind., is dead of heart disease. He is survived by three sons and two daughters.